THE

ELECTRICAL REVIEW.

VOL. XLII. JUNE 10, 1898. No. 1,072.

CONTENTS:

	PAGE
Dynamo Design in the United States	789
Applications of Electricity on a Modern Warship	791
Vibrating Cable Relay (*illustrated*) (*concluded*)	792
Consulting Engineers	794
Prepayment Meters (*illustrated*)	795
The Yarmouth Breakdown	796
Metropolitan Railways	796
Management of Electrical Undertakings	796
Switchboard Apparatus	797
Single *v.* Multiple Generating Stations	798
The Municipal Electrical Association	799
Reviews	799
Correspondence:—Prof. Carus-Wilson's Paper	800
Electricity (?) Direct from Water Power	800
Honour to Whom Honour is Due	801
The Chelmsford Fatality	801
The Parliamentary Committee on Electricity Supply	801
The Electrical Engineers Volunteers	801
Business Notices, &c.	802
Notes	812
City Notes	814
Traffic Receipts	816
The Telephone Inquiry (*continued*)	817
New Haven Street Lighting	818
Share List of Electrical Companies	819
The Municipal Electrical Association:—	
Switchboard Apparatus	820
Single *v.* Multiple Generating Stations	824
Management of Electrical Undertakings by Local Authorities	824
The Institution of Electrical Engineers:—The Design of Electric Railway Motors for Rapid Acceleration (*illustrated*) (*cont.*)	825
Electricity and the War	827
Heavy Motor Vehicles at Liverpool	827
New Patents	828
Abstracts of Published Specifications	828

THE

UNIVERSAL ELECTRICAL DIRECTORY

1898

Edition

Price 6s.

H. ALABASTER, GATEHOUSE & CO.

4, LUDGATE HILL, LONDON, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON.

Telegraphic Address: "AGREKAT, LONDON." Code A B C.

Telephone No. 933 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free per Year, 19s. 6d. To *all other countries*, per Year, £1 4s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES,—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 6s. or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU, 23, Rue de la Banque. *Berlin:* ASHER & Co., 5, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 4 Ludgate Hill E.C.

DYNAMO DESIGN IN THE UNITED STATES.

AT the Electrical Exhibition, which was recently opened in New York, a large number of machines by different makers are on view, and our contemporary, the *Electrical World*, has taken this opportunity of comparing the several designs, and has drawn therefrom certain conclusions as to the direction in which modern practice is moving. These conclusions are published in a recent editorial, and as the subject will probably be of interest to many of our readers, we propose to briefly enumerate some of the leading features mentioned. First, we learn that multipolar machines steadily grow in favour as compared with two-pole machines, and that slow speed machines are now made multipolar for as small an output as one-half horse-power. Steel is not so much used as formerly, a common construction now being to use cast-iron yokes with cores or pole tips of wrought-iron plates from one-eighth to one-quarter inch thick. The yokes are generally circular in form, and wide enough to entirely cover the magnet bobbins; these latter being often further protected from possible mechanical injury by arranging an inward flange at each side of the yoke, so that the bobbins lie in a sort of trough. With regard to the magnet winding, it is stated that edgewise tape winding is beginning to be used for the series coils. Smooth core armatures, we are told, have practically disappeared from up-to-date design, deep parallel-sided slots about half the width of the teeth being most frequently used, although some makers prefer an overhanging tooth with a very small gap between the tips of adjacent teeth. In this case no bands are used, and even with the parallel slot bands are often replaced by the insertion of long strips of wood running the whole length of the armature, and held in place by being fitted into notches just beneath the tips of the teeth. A notable feature of modern design is the increased induction in the air-gap, the use of enlarged pole pieces to increase the area of the air-gap having been largely abandoned; whilst in some cases this increasing of the magnetic density is carried to the point of bevelling the magnet cores at the poles so as to reduce the area of the air-gap below that of the magnet limb. The object of this design is to reduce as much as possible the distortion of the field under load, and this practice has arisen owing to the demand for a machine that will run sparklessly without changing the position of the brushes from no load to 25 or 50 per cent. overload. The carbon brush is almost universally used, even for 100-volt machines, and is invariably arranged radially or nearly so; the brush-holders being of various designs, very generally carried on two rings, one positive and one negative, which serve both for mechanical support and electrical connection of the brushes at the same potential. With regard to commutators no great changes are noticed, except a tendency to increase the area of brush contact per ampere, this being

done by increasing the diameter of the commutator whilst keeping the length unaltered. Although the exhibition does not include any examples of the very big output machines now made for traction and power transmission, it is, says our contemporary, of very great technical interest, and besides many examples of moderate-sized machinery of various designs, it contains a very good collection of dynamo and motor accessories, arc lamps, switchboards, and other apparatus.

Overcoming High Resistance in Crookes Tubes.

In the *American X Ray Journal*, April, 1898, Dr. Graves makes some very interesting remarks on methods of restoring X ray tubes which have become "dead" by increase of resistance in use. He considers that by proper treatment any "dead" tube may be made to work again, without re-exhaustion, or without the use of restoratives, such as vapour emitters in side pockets. Dr. Graves's treatment consists in a rational combination of certain artifices already known and applied separately. The principal artifices employed by Dr. Graves to resuscitate "dead" tubes are reversal, spark-gaps, and tinfoil on the cathode end of the tube. He finds that in tubes of an ordinary resistance, the direct resistance is about three times the reversed resistance. When, therefore, the current refuses to pass in the proper direction, the chances are that it will be able to pass when it is sent in the reverse direction through the tube. If it is found impossible to send the current through the tube even in the reverse direction (when the leads are connected directly to the tube), then success will usually be attained by introducing a spark-gap between the tube and the negative terminal of the generator. Dr. Graves has repeatedly observed that a spark-gap at the negative pole reduces the resistance of a tube, while a spark-gap at the positive pole increases it. The reversed current is sent through the tube till the phenomena observed are the same as when an ordinary tube is reversed. Dr. Graves maintains that tubes that have been resuscitated in this way are far more efficient than new tubes which have not yet become "dead" by continued use. Dr. Graves's paper is well worth the study of those engaged in practical X ray work.

Some Notes on Boiler Trials.

In making boiler tests, it is rightly observed by Mr. Schweder in his paper to the South African Association of Engineers, that complete trials are lengthy. He advises means whereby the action of a plant can be followed continuously. For this he would analyse flue gases frequently, so as to approximate the ideal of 15 per cent. of carbonic acid in the gases. Average analyses only showed 10·8 per cent., and once only had he found 15 per cent. The Arndt econometer is recommended as giving, with a fair degree of accuracy, the ratio of CO_2 in furnace gases, and it will justify its title if the fireman can be induced to fire to its indications, either by pride or by a bonus on results. We drew attention to this instrument when it first came out, and advised its employment as a means of paying firemen by the piece, so to speak—that is, by the proportion of CO_2 they manufacture. Furnace temperatures are computed by means of a piece of copper held in a piece of gas pipe a few inches above the fire. The copper is quenched in water, and the temperature computed from the final temperature and specific heat. Mr. Schweder has had made a new instrument for measuring the velocity of the furnace gases for the purpose of showing the amount of air that is being used for a certain amount of coal. It is not clearly described, but appears to record by means of a nearly horizontal water-gauge tube such that a little difference of head gives a long range of reading. The instrument is the design of Prof. Buknagel, and should Mr. Schweder read this, we hope he will send us a drawing and full description for our columns.

The Magnet and the Spectrum.—Mr. F. Charles, of Bristol, writes the following very interesting letter to the *Engineer* as follows:—"At a time when so much attention is being paid to X rays and new developments of the theory of light, it will not be inappropriate to direct attention to a passage in the *British Cyclopædia*, published by Orr and Smith, Amen Corner, in 1835. The passage in the article on 'Spectrum' runs as follows:—'One of the most extraordinary effects which has resulted from the action of coloured rays is the communication of magnetic powers to metallic bars. Dr. Morichini, of Rome, was the first person who discovered the properties which he considered were confined to the violet rays. At that season of the year when the light of the sun is most powerful, he admitted it into his chambers, and having formed a coloured spectrum by means of a prism, he collected the violet rays in the focus of a convex lens, and by moving the lens parallel to a steel needle, he made the focus of the violet rays pass from the middle of one extremity of the needle to the other, and always in the same direction, without touching the other half. By continuing this operation for nearly an hour, the needle was found to be completely magnetised. . . . . The same result was obtained by Dr. Carpi at Rome, and Mr. Cosimo Redolfi at Florence. . . . When the violet light was passed through the thick smoke of burning sugar, the needle showed only a very slight degree of magnetism.' Further on it is explicitly stated that in 1817, when Dr. Playfair was in Rome, he saw the same experiment carried out with perfect success. Perhaps some of your readers can tell me whether these statements are true or not."

The Ameer and the Dynamo.—In the whole annals of the engineer in the East, probably no man has achieved in so short a time as honourable a record of difficulties overcome and conspicuous success attained from the smallest beginnings as Sir Thomas Salter Pyne, C.S.I., M.Inst.M.E., and C.E. The extent of confidence reposed in his ability by H.H. the Ameer of Afghanistan has been more than justified by the varied and far-reaching industrial developments which, under the enlightened patronage of the Afghan ruler, Sir Salter has created in the midst of an unsympathetic and fanatical population. The story of Sir Salter Pyne's rapid success is a testimony to his solid worth of character and indomitable energy in a position from which a predecessor, after a short inspection of Kabul amenities, hastily retired dismayed. To enter a country in which the worst traditions of the East prevail, his only guarantee the somewhat filmy protection of a ruler suddenly become interested in mechanics, as a child might be in watching wheels go round, to retain that interest and form it in the direction of serious work, to erect and equip workshops, foundries, mills, and to establish a dozen or more useful industries, and, above all, to make 3,500 skilled mechanics out of the typical Oriental material before him—all this is surely an achievement which can only be described as grand. The solid fact of this industrial activity set going in a land amongst a people whose energies knew no other outlet than that of warring against their neighbours, is sufficient to place Sir Thomas Salter Pyne in the front rank of the pioneers of civilisation. Great things often originate in small beginnings, and this great enlightenment of the Afghan people may be traced to a dynamo which one day the Ameer, when on a visit to India, lingered to watch at Rawal Pindi. It is from this incident that the great interest in applied mechanics which the Ameer now possesses may be dated, and which has given the subject of our note the opportunity of which he has so well availed himself. The Ameer retained the services of the engineer in charge of the plant, who happened to be a Frenchman, but that gentleman, after a brief experience of Kabul, took an early opportunity of returning to his beloved boulevards. He was succeeded by Mr. Pyne, and from that date Sir Salter's career has been one of uninterrupted success, not only in his own professional lines of activity as a civil and mechanical engineer, but also in the more exacting domain of confidential agent to the Afghan ruler.

APPLICATIONS OF ELECTRICITY ON A MODERN WARSHIP.

There is little doubt that the Americans are far ahead of us in their applications of electricity on board ship, and if only Admiral Sampson can force the Spanish fleet, now said to be "bottled" up in Santiago de Cuba, to a pitched battle, it is possible that the lessons which electrical engineers will learn from the fight will be as important in their way as those which will be gathered by students of naval strategy, and of armour *v.* gun.

Even the most sanguine of electrical engineers do not look forward to the use of electricity in propelling warships: at any rate, they do not expect that this method will be adopted in the near future; but they are without doubt right in claiming that electricity is by far the best source of power for driving the auxiliary machinery of the modern man-of-war. The American naval authorities, more than those of any other country, have realised the importance of this, and should a really serious action take place between the hostile fleets, we shall eagerly watch for official reports on the behaviour of electrical systems in actual warfare.

The presence of steam and exhaust pipes anywhere outside of the main engine and boiler compartments is undesirable, especially in the crews' living quarters, where the heat that they produce in confined spaces densely inhabited is particularly bad. In addition, the presence of complicated steam appliances in various parts of the ship adds to the work of keeping the vessel clean. These, however, are minor disadvantages. A greater one is the obvious danger in action from steam pipes placed above the protective deck. This is met by placing below the protective deck all auxiliaries whose use would certainly be necessary in battle, and by shutting off steam from all the rest below the protective deck when the ship is cleared for action; but the capstan and the winches must be on deck, and their use may become imperatively necessary in action. The cutting of the steam pipe, above the protective deck, to any of the machinery, would render some of the ammunition-passing rooms entirely untenable until steam could be shut off from below, to say nothing of the probable loss of life and disastrous moral effect.

By far the most serious objection to these auxiliaries, however, is their lack of economy. Everybody knows they are wasteful, but just how wasteful it is difficult to say, because of the rarity of tests under service conditions. About a year ago, however, engineer W. W. White made a series of very careful experiments on the auxiliaries of the *Minneapolis* (U.S. Navy). In these experiments the condensed exhaust was measured and indicator cards were taken from 13 different auxiliaries, beside the dynamo engines, including main and auxiliary air and circulating pumps, pumps for feed, fire, bilge, flushing, and water service, one forced-draft blower, and the ice machine. The mean result from these 13 was 99·522 lbs. of feed-water per I.H.P. per hour. The greatest economy was shown by the middle circulating pump engine, a simple, vertical, two-cylinder, inverted, direct-acting engine, with slide valves, actuating two centrifugal pumps. At the time of test the pump was working under its full load. The consumption was 55·06 lbs. of feed-water per I.H.P. per hour. The least economy was shown by a horizontal duplex pump, 12 inches × 8½ × 10. At the time of test it was making an average of 12·7 double strokes per minute on a very light load. Its consumption was 318·68 lbs. of feed-water per I.H.P. per hour.

These results are certainly startling. We have, of course, always known that the auxiliaries were very extravagant in the use of steam, but who supposed that there were engines to-day using from 100 to 300 lbs. of steam per I.H.P.? In an official summary of tests to determine the consumption of steam of the main and auxiliary engines, we find there are 34 auxiliaries having in all 52 steam cylinders. Thirty-one of these engines were indicated, giving an aggregate of 471 H.P. developed, using collectively 56,049 lbs. of water per hour, or an average of 119 lbs. per I.H.P. Were these auxiliaries as economical as the main engines, 9,891 lbs. of steam would have developed the same power. 46,158 lbs. of steam or water being used *more than is necessary* if the best conditions of economy prevailed. In other words, the data show that at 8 lbs. of water evaporated per 1 lb. of coal, 5,769 lbs. of coal can be saved per hour.

It must, of course, be borne in mind that it is impracticable to realise this gain because of the complications which would follow the introduction on board ship of high-expansion engines for these numerous purposes, but the question is, shall these numerous engines for so many purposes be replaced by fewer engines of higher character and have a few central-power plants capable of meeting similar wants with greater economy; or shall we design more economic engines for each individual condition, even at the cost of a slightly increased number of parts; or shall we have one more economical central steam-plant developing power to be distributed by electricity to the varied requirements in different parts of the vessel?

Wastefulness is inseparable from any system requiring the development of power in numerous independent engines of small power situated at a distance from the boilers. Under such circumstances the losses by radiation and condensation must necessarily be greatly increased. Then, too, the use of numerous small engines causes a great increase of the friction load. Worst of all, each of such small engines must be large enough to do its maximum work; hence, under service conditions, it must often work at low power with great waste of steam.

These troubles can be avoided by the use of one power plant for all the auxiliaries. Such a plant for a large man-of-war could be divided into a sufficient number of units, so that the generators in use could always be working at nearly their full load; and at the same time the units would be so powerful that compound engines could be used with consequent economy. In addition there would be the gain from the substitution of a few large engines for many small ones. The plant, of course, would be placed near the main boilers, avoiding much steampipe drop and condensation, would be below the water-line and well protected, and would keep its heat, dirt, and noise in the machinery space.

In the *Engineering Magazine*, Mr. George H. Shepard discusses the applications of electricity on modern warships, and indicates the direction in which it may be most usefully employed. He is a great advocate for central power plant. In order to run this to the best advantage by keeping its load as nearly uniform as possible, the distribution to the auxiliaries should be by electricity; the dynamos for electric lighting being continued to run by steam. By this means, when the night's lighting load goes off, the day's motor load could be put upon the same generators, instead of running two sets of generators, each at light load and heavy load alternately—a necessity under any system of distribution. There would, of course, be variations in the load; but electric light and power stations equipped with several units, operated by condensing engines, can run under wide variations of the total load, without greatly changing their steam consumption per I.H.P.

Electricity is very adapted to the conditions existing on board ship. The wires can be carried through watertight bulkheads with less damage to the latter than that caused by the pipes necessary for any other system of distribution. For the short distances existing on board ship the transmission losses are negligible. In starting machinery electricity can be applied with a quickness, certainty, and safety attainable with no other power, except possibly compressed air, whilst distant motors can be controlled from the central station.

It must be admitted that most naval officers regard electric machinery on board with distrust, so that at present it is chiefly used only for illumination, search lights, communication, and to some extent for signalling. Perhaps the dislike for electric machinery arises from the fact that electric call-bells and telephones on board ship frequently get out of order, whilst a fault in the electric mains is hard to locate, but such disadvantages as have been experienced are probably due in most cases to the restrictions and interferences which electrical engineers have to contend with when putting in installations on board a man-of-war, for it cannot be said that electric machinery deserves a bad reputation, although the conditions on board ship are very trying to electrical appliances.

Naval architects should try and meet electrical engineers more leniently, for the advantages to be gained by giving electrical appliances a fair field are enormous.

Mr. Shepard carefully examines the advantages and disadvantages of replacing steam auxiliaries by electric auxiliaries, and puts his finger upon the chief difficulties in using complete installations of this kind. He concludes that although electric auxiliaries offer many advantages, their great cost and the amount of space they would occupy render a complete installation of them of doubtful benefit, while their great weight makes it absolutely out of the question under present conditions. It is to be expected, therefore, that the present mixed system of power distribution will continue aboard ship, possibly as long as the steam engine remains the prime mover, but that electric appliances will never occupy a much more important place there so long as present ideas obtain. However, there is every reason to hope that, with continued progress, both amongst makers and users of electric machinery, it will gradually become more and more adopted aboard ship for those purposes for which it is peculiarly fitted. The necessary power will probably be furnished by a gradual expansion of the present electric light plant to meet the new demands. What the limit will be depends upon the future improvement in electrical appliances, especially in the matter of weight, and upon an increased disposition among naval constructors to design their plans in such a way that whilst the efficiency of a man-of-war as a fighting machine shall not be impaired but enhanced, more scope shall be allowed and more opportunity given to the electrical engineer for the practical solution of those difficult problems connected with the distribution of power to auxiliary engines.

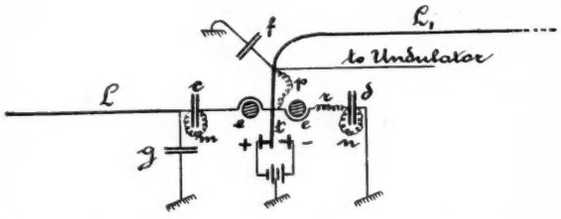
VIBRATING CABLE RELAY.

By K. GULSTAD.

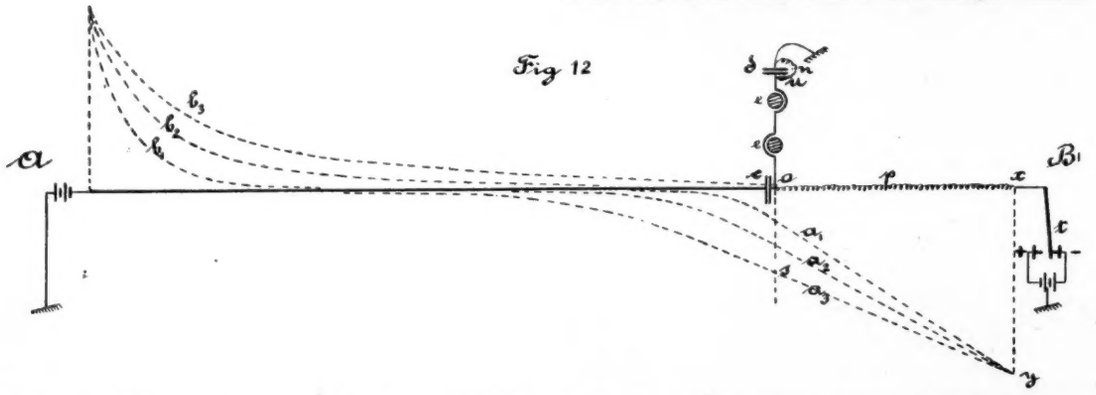
(*Concluded from page* 752.)

It is not always necessary to employ special windings for the vibrating current; some advantage might possibly be gained by an arrangement, as in fig. 11, or in principle as sketched out in diagram, fig. 12, where the tongue, for the

Fig 11



sake of clearness, is placed apart from the electro-magnets, and where the resistance, p, for the same reason, is joined up as in fig. 5.



To limit the subject, I shall try to explain the working of the relay arranged in this manner only.

Let us suppose that the vibrating apparatus is put into action by switching the resistance, p, fig. 12, on to the cable at point o, while the transmitter at the sending station, A, sends a series of dots into the cable, p being chosen so that the rate of relay impulses is the same as the rate of dots.

Considering the instant, when the armature has been moved against, say, the right-hand contact, a negative current is sent through p into the cable end at the relay station, B, thereby decreasing the potential throughout the line. In fig. 12 this decrease at different periods of time is roughly illustrated by the potential curves, a_1, a_2, a_3, the ordinates at any point representing the potential, which, at the tongue, is $x\ y$. This fall will evidently continue till the potential at point o has dropped to, say, $o\ s$—*i.e.*, so far, that the negative current through the relay windings is sufficiently strong to move the armature and press the tongue against the left-hand contact, whence a positive current is then sent into the cable, &c. The time elapsing from making till breaking contact thus depends upon the potential at o due to the relay battery, and it is further evident that the time also will be influenced by the sending current, that tends to increase or decrease the potential, as the case may be. In fig. 12 the potential curves for a positive sending current are indicated as b_1, b_2, b_3. If a positive sending current increases the potential at o a little just before it has fallen to $o\ s$, the time for the reversal of the tongue will be prolonged. If the sending current, on the other hand, is negative, the time will be shortened. In general, the interference of the sending currents will therefore, after a little while, bring the vibrations of the relay tongue into unison, and practically into synchronism with the reversals of the transmitter, and in such a way that, while the transmitter sends a positive current into the cable, the relay will send a negative current into the cable at the other end, as well as into the line L_1, fig. 11, or *vice versâ*.

How soon this synchronism is established depends, of course, upon the strength of the line current; suffice it to say that a relatively weak current will soon be able to control the motion of the relay armature, even if the resistance, p, is not exactly corresponding to the rate of dots. In case the action of the dots is quite negligible, sufficient synchronism would, however, be established as soon as the action of the dashes commences; all that is wanted is that the influence of these signals of longer duration are strong enough.

From this it will be seen that only positive and negative dashes at certain intervals are necessary for signalling, it being of minor importance whether the dots penetrate or not, as the relay itself will fill up the intervals between the dashes and spaces with the number of dots needed. Obviously the very circumstance that this Morse code signalling can be practised by means of dashes and spaces, involves the possibility of increasing the working speed of cables or long landlines, where vibrating relays are employed.

When I have mentioned the arrangement, fig. 11, as probably being preferable to that shown, fig. 10, it is not only for the sake of convenience, but also because a partial diminution of the effect of the charge appears to be attainable.

Referring again to fig. 12, it has been pointed out that whenever positive dots are sent into the line from A, a negative current is simultaneously forced into the cable at B, or *vice versâ*, and the same refers to the sending of dashes. As the current direction through the cable is the same, a portion of it nearest B will be charged oppositely to the length of cable nearest A, the two charges being separated at a point of zero potential. Whenever reversals take place, a portion

of these opposite charges will tend to neutralise each other, thereby diminishing the time for the succeeding re-charge from both cable ends. On account of the sensitiveness of the relay—even with pole-pieces quite up to the armature—a feeble charge only can be sent into the cable from B, in case p is placed as is fig. 5, and it is partly to try the effect of increasing the charge due to the relay current that I have applied p as described (fig. 6, &c.).

It has been mentioned that the effect of distortion will be diminished by making the relay vibrate in a proper manner (*vide* fig. 3). Going further into the matter it will be found that the diminution can be effected to a greater extent than might appear possible at the outset. The question of dots being of minor importance for high speed work, the formation of the dashes is the only one to be considered as regards the speed of signalling. To make up for the distortion of the dashes, the tongue must leave the contact on which it rests as soon as the time for the dash is elapsed. The decrease of the negative potential due to the relay current at o, fig. 12, must, for instance, correspond to the increase of the potential due to the sending current, or *vice versâ*, in such a manner that the differences between the resultant potential at o, and the equally varying potential at u, will cause the tongue to be reversed, whenever the relative strength of the cable current diminishes. Up to this moment the tongue will be kept against the contact by the attraction of the armature, which action will continue as long as the flow of electricity from B can be neutralised by the flux of opposite signed electricity from A.

In order to ensure a satisfactory working of the vibrating relay, it is therefore not sufficient that it vibrates at a certain rate; this can be attained in different ways, but it must vibrate so that the relay current through the windings also increases in a special manner. This can be accomplished by proper variation of the condenser capacity, or of the resistance r, of course, at the same time altering p for maintaining the rate of vibration. For the sake of extending this variation, a condenser, g, fig. 11, may sometimes be added with very good result.

The manner in which the variation of the condenser capacity affects the working of the relay is illustrated by the record of signals upon undulator slips marked figs. 13, 14, 15.

As to the regulation, the same holds good as for duplex working, it is chiefly a matter of experience, patience, and perseverance, although certain rules can be given. When, however, the right "balance" is found for the maximum speed, it is likely to be steady from day to day, and only to need small corrections. When the speed is lowered a new delicate adjustment of the condensers is not required, as it is generally sufficient to alter the resistances, p, and sometimes r.

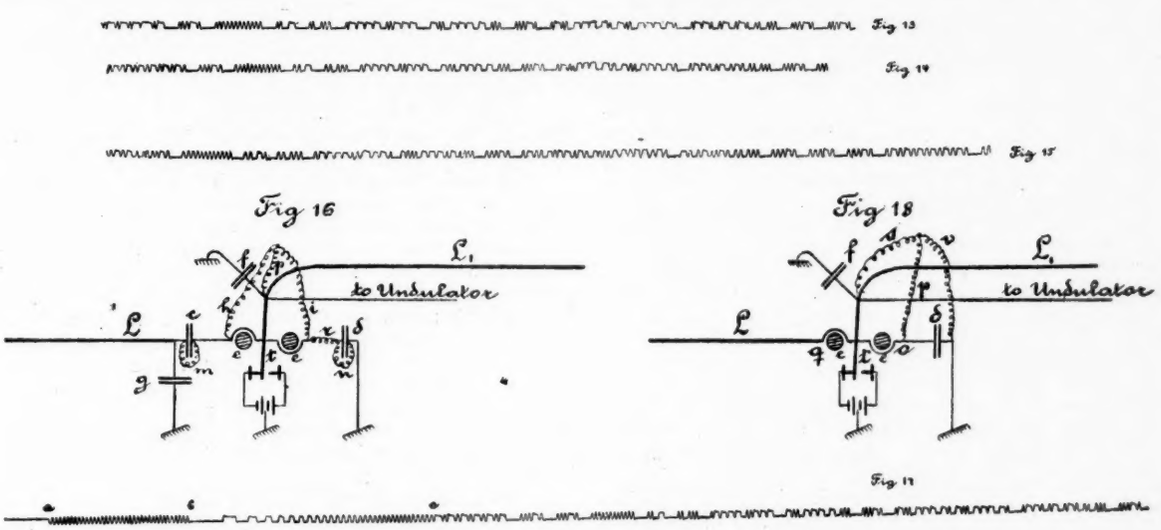
Referring to fig. 3, it may be said that the regulation is intended to prevent the top of the dash or the space from extending much above or below lines m_1 and n_1 respectively. This is possible even with a series of dashes sent, from the fact that the vibrating relay also sends an equal series of negative dashes into the cable, thereby producing corresponding phenomena of charge.

The above regulation is dealt with as if it was undertaken from the receiving end only. It is, however, clear that the same thing can be done to some degree from the sending end, all the effects of variation of current—by altering the battery power, by compensation, by employment of sending condensers, &c.—being at once noticeable on a suitable recording instrument, such as the undulator. The manipulations at the sending end must at the same time only be looked upon as a means of facilitating the adjustment at the relay station.

By the use of the vibrating relay, the distortion of signals on undisturbed lines may be compensated for and eliminated to a considerable extent in conformity with the "balancing" applied in duplex working. The arrangement, fig. 11, is the same in several respects as the one employed in the differential duplex. "Bridge" connections may also be employed with good results—see fig. 16, where h, i are resistances.

The *modus operandi* for "balancing" is comparatively simple in principle. Let the transmitter station send a series of signals, including a certain number of dots previously agreed upon. The relay station, which switches on the vibrating current as soon as the signalling commences, regulates at first the resistance, p, fig. 11, till the right number of dots is obtained, and subsequently the condenser capacities and resistance, r, for correcting the dashes, then re-adjusting v, and so on.

The slip, fig. 17, records the effects of the transmitter



The records in fig. 13 are very readable, yet it will be seen that the dashes are unproportionally large, and would possibly run together when the speed is increased. In order to increase the influence of the relay current, I may then reduce the capacity of d and likewise the resistance p, fig. 11, the result being as in fig. 14, that the signals become more distributed. Reducing the capacity much more would, however, not do—see fig. 15—as the relay current would then rise or fall too quickly (preponderate) and break the dashes, making the signals unreadable. In all three cases it will be seen from the 12 dots that the rate of vibration is the proper one.

current when signalling begins. The vibrating current is put into action at a, the interference of transmitter currents commences at b, and the proper signalling at c.

The details of construction and the adjustment of the relay may influence the results obtainable considerably. The conditions of the line, L_1, may likewise affect the same, and I consider it, therefore, preferable sometimes not to connect L_1 directly to the vibrating relay, but to the tongue of another ordinary relay, worked by the former.

Regularity of the transmitter motion and constancy of the sending battery are also essential points to be observed, when the system is to be fully utilised.

E

It seems evident that the application of the vibrating relay is not limited to cables, but may be employed on long landlines also. The regulation for dashes and dots requires not be so very exact in the latter case, neither is this necessary on short cables nor when working long cables at low speed. The arrangement, fig. 10, would perhaps be convenient on landlines.* As to duplex working in connection with the vibrating relay, I don't see any objection for employing the same arrangement (fig. 10).

So much for the theory of the vibrating relay. By means of this a very considerable increase of speed on cables or on long circuits, undisturbed by induction, &c., may be looked for, when compared with ordinary relay work. I shall, however, not here suggest to what extent this is possible, the matter being new, and no doubt open to improvements in different respects. I have myself obtained a speed of 80 to 90 words per minute on an artificial line composed of resistances and artificial cables representing something like 700,000 K.R. The system has also been tried practically upon the Great Northern Telegraph Company's cables and landlines from Newcastle-on-Tyne to Gothenburg, *i.e.*, a circuit of about 580,000 K.R., with the result that upwards of 100 to 110 words per minute can be sent from Newcastle and translated at Gothenburg to Nystad in Finland, whenever the landlines are free from external disturbances; if such is not the case, the speed as a matter of course is considerably lower.

It should be mentioned that a modification of the vibrating relay arrangement as described above has been in use on this very cable for many years, and with a very satisfactory result. This modified arrangement—shown in fig. 18—is due to Mr. Falck, the Great Northern Telegraph Company's Superintendent at Gothenburg, who introduced it in order to facilitate the reversal of the relay armature, and who has since improved upon it in several ways. The speed attainable is 65 words per minute. It will be understood from fig. 18 that the direction of the marking current is the same here for the sending as for the relay current, and the diminution of the distortion is consequently caused by the proper variation of potential at the points o and q, both being of the same sign.

called variable zero. An increase of battery power will also to some degree be found advantageous for such instruments, when the condensers are diminished at the same time.

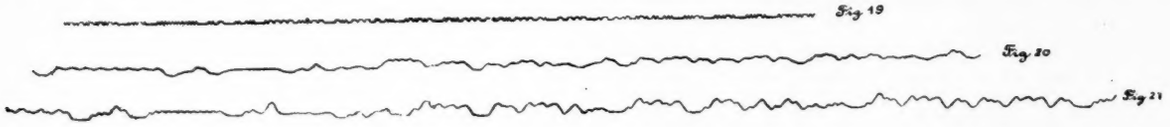
With regard to battery power, it is certainly a capital thing to be cautious, but when speaking of faultless cables, as made nowadays, with a thick insulating coating, occasionally tested with several thousands of volts, a much higher E.M.F. than is generally in use on cables, may doubtless be employed without risk.

Copenhagen, *May*, 1898.

CONSULTING ENGINEERS.

The company promoter is inclined to the belief that he is at liberty to ask an engineer to carry out tests on lines to be laid down by the promoter. It is possible to carry out a so-called test on promoter's lines and obtain results which, while representative of facts obtained under the given conditions, are by no means fair facts to place before a lay investing public.

Recently it appears that the British Hydraulic Jointing Company called in Sir Frederick Bramwell to report upon the invention to be worked or exploited by the company. Sir Frederick's report was lengthy and apparently not so favourable to the promoters as to make them afford space for it in the prospectus. The condition laid down by the author of it was that it must be published *in extenso* or not at all, and the prospectus simply stated that Sir Frederick had reported on the invention and his report could be seen at the office of the company. Of course, not one in a hundred investors would go to see it: they would conclude it to be favourable. But Sir Frederick wrote to the *Times* asking the public to read his report before investing. Many experts really do little else than follow out the instructions of promoters, and they prepare reports of no real value but very seriously misleading, while at the same time they write



To illustrate in some way what the influence of the distortion means, I may refer to the undulator records, figs. 19, 20, 21. Fig. 19 shows signals translated through the mentioned artificial line at a speed of 90 words per minute by means of the vibrating relay. Fig. 20 gives the signals sent through the line direct to the undulator at a speed of 80 words, and fig. 21 the same thing at a speed of 50 words per minute, the conditions being the same in all three cases as far as practicable. When the relay was worked in the ordinary fashion a signalling speed of only 21 words could be attained (impulses to be used).

In conclusion, I beg to remark that when I have limited the speed on the artificial line to 80 or 90 words per minute, it should be understood that this is effected by rather a moderate E.M.F. By increase of the battery power a somewhat higher speed would no doubt be obtainable according to previous trials.

The limit of speed appears, indeed, principally determined by the attenuation of the sending current, and not so much by the distortion of the signals, which can be neutralised, to a great extent, in the way shown. The attenuation can of course be counteracted by augmentation of the E.M.F. till the same has reached the limit which is considered safe for the cable.

The vibrating arrangement may, according to its mode of action, be looked upon as a contrivance for transforming the distortion into an attenuation of the current, *i.e.*, the very same thing which partly is done by condensers in circuit with receiving instruments working with the so-

* If arrangement fig. 11 is used, condenser c and resistance m may be dispensed with.

nothing which is not true. A bicyclist might run along a rut in a road and would be able truthfully to report he had had a smooth journey.

This would read well in a report, but it would not make the whole road surface good. Where an engineers' report is to be employed as a means of floating a company, we think he ought to report on everything he may find concerning the idea or project. Indeed, it is the consulting engineers' right to assume that no matter by whom he is called in, his client's object is to obtain the whole truth. As often as not, however, promoters merely want favourable reports, and are very apt to think they are badly treated when an engineer refuses to carry out a test on misleading lines. We do not think that an engineer called in to report on an invention purely as a piece of mechanism is bound to say that in his opinion it is a non-patentable invention; he naturally leaves such questions to the patent expert, and has a right to assume his employers to be honest enough not to ask the public for money until they have satisfied themselves that the patent is good. It appears from Lord Crawford's letter in reply to Sir Frederick that the report dealt with the question of validity of patents on which Sir Frederick had not been called on to advise, but on which he apparently felt bound to say something. We think in such a case if an engineer doubts the validity of a patent he might simply say, "as regards the patent I would advise you to obtain the opinion of some expert." We have known would-be promoters very strenuous in asking consultants to give them facts when they hoped or expected such facts to be favourable, and to be exceedingly annoyed when the facts were unfavourable. Whatever extent may be covered by an engineer's report, there can be no question that on the points he does deal with he

should refuse to admit any course of action which makes for results that cannot be obtained commercially. A hard and fast rule to cover every case it is not possible to lay down. Every case must be its own law, and an engineer must necessarily be guided by what he finds in each case. He will find out for himself whether the intention of his employers be really honest or otherwise, and act accordingly.

PREPAYMENT METERS.

The popularity of a prepayment system in connection with artificial illumination is undoubted. It has strengthened the unsecure tenure of the gas companies by creating a handsome revenue from a section of the public which is commonly reputed to be beyond the civilising influences of quarterly accounts. Light is a necessity even to the submerged tenth, and the essential principles of prepayment were quickly grasped by it.

It was discovered that a pennyworth of gas went further than oil, and was immeasurably more convenient. The fact that it was infinitely safer than the devastating oil lamp may

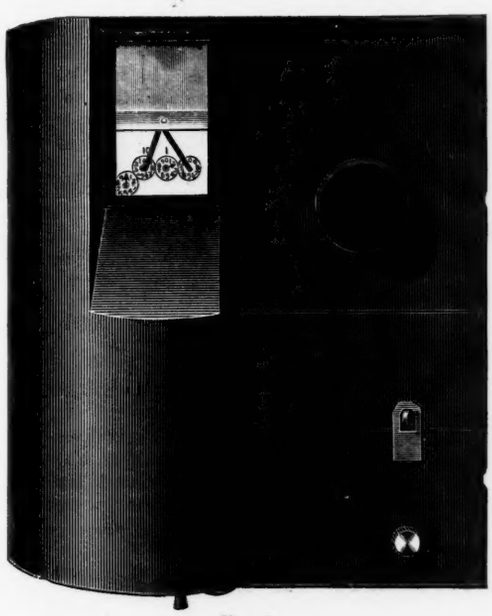


Fig. 1.

not have counted for much, but no doubt the prepayment gas meter has operated very effectually in this direction. The prepayment system, however, has extended beyond the poorer classes of the community, and is not uncommon in the flats and domiciles of the well-to-do. With the success achieved by the gas companies so prominently displayed, it was not surprising that attempts should be made to apply the principle to electric lighting, and Mr. C. O. Bastian, whose electrolytic meter has been discussed a good deal of late, has been working on the subject for some two or three years. The prepayment electric meter devised by Mr. Bastian has gone through quite an evolutionary process before arriving at its present form, the chief modifications tending towards a simplification of the instrument.

This prepayment arrangement does not imply a special form of meter, for the device can be attached to any of the well-known types of meter. The illustrations by which we shall strive to explain the working of the instrument show the prepayment mechanism applied to a Thomson watt-meter. The operation of the instrument, by means of a coin, is an interesting and ingenious one. Until a coin is inserted, the handle which projects from the cover is free to move; a coin, when pressed through the slot, falls into a groove, and forms a rigid connection between the handle and the interior mechanism, and a turn of the handle switches on the current. The arrangement of the meter will be better appreciated by referring to the detailed parts. Fig. 1 shows the meter and prepayment attachment entirely enclosed, which is the form in which the mechanism will be usually sold. Fig. 2 is front view of the meter, the only features to be noticed here being the coin receiver or shoot shown at O, and the pointers N, N, the exact function of which will be referred to subsequently. Fig. 3 gives a detailed view of the prepayment mechanism seen from the

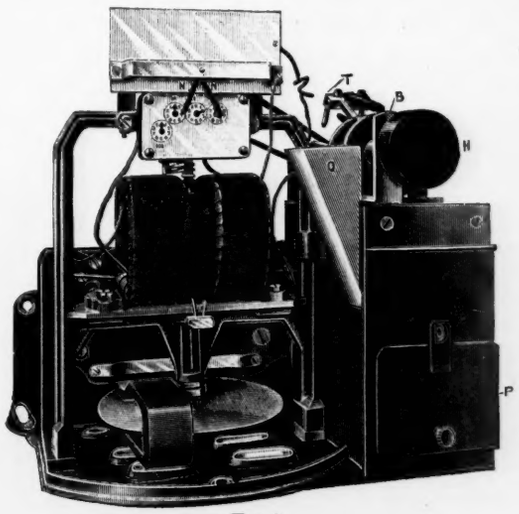


Fig. 2.

back of the meter. We will now follow the action of the apparatus. Upon the insertion of the coin at B, which makes a mechanical connection, the handle, H, is turned. One result of this is to operate on the pivoted end of the switch, T, which is depressed into the mercury cups, M, thus completing the circuit through the meter. The switch is held in the mercury cups, against the tension of a spring, by

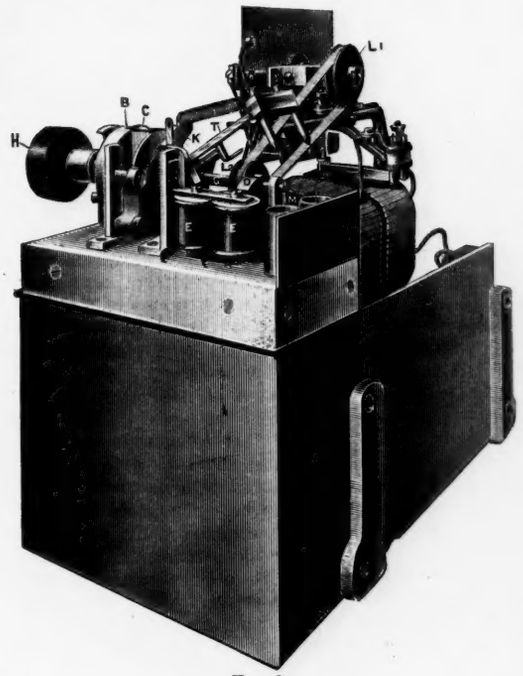


Fig. 3.

means of a clutch, D. The turning of the handle does more than merely put the switch on. In fact, the operation that we are about to describe is probably the most important in the complete action of the mechanism. Above the dials of the meter (fig. 2) will be observed two pointers, and the relation of these to one another is very important. The handle H, being in connection with a rod, G, its movement will cause a

partial revolution of the pulleys, L_1 and L_2. These pulleys are connected together by means of a miniature raw hide belt; pulley L_1 is mounted on an axle, which carries one of the pointers already alluded to. It will be seen, therefore, that when the handle is turned, one of the needles, through the medium of the pulleys, is moved away from the other pointer, the exact distance of its movement being predetermined. The second pointer is geared to the train wheels of the meter, and when the switch has been put on by the agency of a coin, the meter commences to run, and the second pointer travels slowly after the first one. The exact distance it has to traverse before it overtakes the first pointer is a measure of the current consumed; in fact, the first pointer is caught up by the second pointer in a time inversely proportionate to the amount of current flowing through the meter. The distance that the first is separated from the second is determined by the gear wheels, which are proportioned according to the price per unit and the value of the coin with which the mechanism is intended to be operated.

The more coins that are dropped in, up to a certain limit, the further the first pointer will be separated from the second, and they will be a proportionately longer time in coming together. One side of the first pointer is insulated so that it can come in contact with one side of the second pointer with impunity. The other side, however, carries a platinum contact, and when the second overtakes it and comes in actual contact, a current of electricity at once flows round the electromagnet, E, whose armature is immediately raised, and pulls the clutch, D, away from the switch, F, which immediately flies into the off position.

From observations we have made the action of the meter seems to be certain, and the instrument ought to meet with considerable success.

THE YARMOUTH BREAKDOWN.

The report of Mr. Preece upon the recent breakdown at Yarmouth is a little curious for two reasons. He does not advise the use of separators for the prevention or, rather, dealing with priming water. One reason is the heavy expenditure, £250, that would be involved. Granting that the expense would be so much, is the sum an extravagant one as an insurance against such a breakdown as occurred? which must have involved an expense directly and indirectly very much greater than £250. Then, again, if separators are what they profess to be, can it be held that a station is complete without them and, their omission having proved so provocative of disaster, ought not such omission to be remedied at once. Further, the wasteful effect of wet steam is such that if separators do their duty the economy in fuel which they bring about must be such as to very amply repay the expenditure upon them. Every pound of water separated from the steam represents the destruction in the cylinder of steam probably equal or nearly equal in amount to the water. Separators are not merely to be regarded as such for safety but also for economy.

But Mr. Preece did not stop at one reason. As a rule separators are provided with a water-gauge and are blown out periodically by the attendant when a given amount of water has been collected, and any neglect to do this may lead to the very disaster intended to be averted. This is correct, but it ought not to be. Separators ought to be drained automatically. The ordinary steam trap which, of necessity, discharges water at a temperature above the atmospheric boiling point, is looked upon as a nuisance, for it practically discharges steam. What is wanted is a good steam trap of large opening discharging into a closed pipe which may be carried to the suction side of the feed-pump whereby all water is returned to the boilers. Where the arrangements are suitable steam separators may be drained direct to the boilers, but not below water-level, and they should have discharge pipes as large and direct as possible.

In a station recently inspected by us there were separators not merely to each engine, but also on the main steam pipe, which we regret to say was a ring main, an appliance far more likely to cause trouble and breakdown than to prevent it or safeguard against its occurrence.

METROPOLITAN RAILWAYS.

The problem of fitting the Metropolitan Railway with electrical traction offers considerable difficulty in the opinion of the *Engineer*. Many of these difficulties come in with the numerous junctions of other railways, as the Great Western, Midland, Great Northern, which, running upon the Metropolitan, make it an open question whether—at least at first—there should not be both steam and electrical working. This in itself does not seem very terrible. With only half the trains worked by steam, there would be considerable improvement in the atmosphere. The directors of the line are, of course, greatly pleased with the antiseptic nature of their tunnel atmosphere. We prefer it ourselves to the unchanged foulness of the unventilated buried electrical railway. While the electrical lines are bound to keep their tunnels little worse than the outside atmosphere, we would tell the Metropolitan directors that they are not bound to maintain their shallow tunnels in better condition than the atmosphere. The philanthropic provision of an antiseptic atmosphere is doubtless kindly meant, but the public are willing to forego the boon. Our contemporary calls on the Metropolitan Company to provide lifts at the stations, facilities for some amount of personal luggage, clean stations, and generally such comforts as would remove the line from the stage of barbarism from which it never seems able to emerge. We think if the Metropolitan Company really set itself to the task of electrical working that the difficulties anticipated would disappear as they came to be grappled with. That it would involve an enormous capital expenditure to put in electrical equipment is undoubted, but we have previously shown that a comparatively small addition to traffic would find an income to pay interest on such outlay, and there can be no doubt that if properly managed the dirty underground might become a clean and paying undertaking. As our contemporary implies, the line has been so brutally managed in the way of dirt and roughing it, that the "system has never had a fair chance yet," and while electricity would be valuable, it is doubtful wisdom to introduce it except in company with other much needed improvements. American experience in electric traction is sufficient to show us that the mere factor of working expenses is not of much moment. Grant that the train mile cost is increased, this can matter little, so long as the receipts more than proportionately grow. It is to this end that electric traction will tend.

MANAGEMENT OF ELECTRICAL UNDERTAKINGS.

The paper on the above subject by Councillor Hesford, read before the Municipal Electrical Association, is not remarkable for its originality. He begins by stating that electrical undertakings can be efficiently administered and profitably managed by local authorities, but he omits to say that such undertakings can be, and sometimes are, inefficiently administered and badly and unprofitably managed by local authorities, particularly when the gas interests of the authorities are interfered with, when individual members of Committees have their own irons to warm, or when political parties fight their battles without regard to anything but the final supremacy of their particular party. After referring to the well-known apathy of local authorities respecting electric lighting, the author proceeds to enumerate the difficulties to be met by those Corporations who decide to take up the electric lighting business.

We are glad to learn from Councillor Hesford that "Every Committee know what they want," and according to him, "It is a station and system of distribution that shall be second to none. It must be planned for utility and convenience, and meet the unknown wants of futurity. Its machinery should be designed to adapt itself with precision and success to all the varying requirements; work at a cost that shall top the record and be obtained from the lowest tenderer. These are the ideals, and the question is how to get them." Exactly; and the writer does not go very far

towards trying to perform the obviously impossible task of explaining how it may be done, but contents himself with dwelling upon the idiosyncrasies of the consulting engineer, and the troubles of the Committee, who find that everything is wrong in their station after it has been running for a time. Bad design, buildings too narrow or too short, day plant too small, are amongst the discoveries made, and a scrap heap becomes necessary. Start a reserve fund, says Councillor Hesford, in order to provide for these contingencies. Very good advice, but not original, as we fancy the Local Government Board will sooner or later point out to those Corporations who omit such an obvious precaution.

The author is of opinion that "the primary and foremost duty" of a Committee is to break the record of low costs, and plainly states that the comparative cost-tables published by a contemporary show up the failings of undertakings. Here we must disagree with the worthy Councillor, for however valuable such comparative tables may be, a low works' cost does not of necessity mean good design or management, nor does a high cost mean bad management or design, and before any fair comparison can be made, a deal of further information would be required.

A station in which the staff are paid fair and proper salaries and wages cannot compete in the question of costs with another station worked largely by premium pupils. To endeavour to work a station economically is laudable and an obvious duty, but the attempts of some committees to cut down salaries and wages and to generally starve their works is little short of a scandal, to which we fear the electrical engineer is sometimes a party. The writer complains of the cost of distribution, and looks forward to the time when its reduction will bring the light within reach of the poor man, but we are afraid the poor man will have to wait a long time if cheap light necessitates much cheaper distribution. He considers that street lighting by electricity must wait until the cost is materially reduced, "as corporate gas committees are tough, thick-skinned gentlemen." We are afraid we are uncomplimentary enough to consider them thick-headed also; surely one way of reducing the cost would be to go in for it on a big scale. But do they desire it at any price?

A few remarks on charging, in which he suggests that the lowest price per unit should be aimed at consistent with covering all charges, and a general lamentation that the breakdown of steam plant prophesied does not occur, while faults on mains not foreshadowed are frequent, brings the paper to a close. Councillor Hesford's advice is—Start a reserve fund, break the record for low costs—anyhow—but break the record, and reduce the cost of distribution.

Apparently good management does not include the giving of an efficient supply, as this is not mentioned.

SWITCHBOARD APPARATUS.

Mr. J. R. Blaikie's M.E.A. paper under this heading, is of the type to excite discussion, and switch-gear has not yet reached the stage when engineers feel that there is little more to be done than maintain what is in use. Low tension supply may be fairly secure on this point, as only in individual stations is the switchboard unsatisfactory, but one cannot believe that the largely varying types, forms and sizes, are necessary or desirable. For complication, it is admitted that three-wire boards easily beat those employed in alternating distribution, and this is to be expected. The use of batteries, motor-boosters, and such like auxiliary apparatus, complicate the switch-gear without making it unmanageable.

Mr. Blaikie, however, principally deals with alternating boards, as might be anticipated. It is with this class that the greatest divergency of detail and arrangement is to be found. Frequently the combination is unnecessarily intricate, but we would not care to go as far as the author in attributing it to ignorance or vanity. After all, what is wanted is a reliable and well-designed set of details, switches, fuses, and regulators, and the board as a combination of these should be the result of the responsible engineer's requirements, and adapted to suit the local conditions. This seems to be rather overlooked in the paper, for, take a modern station, arc lighting is gradually extending, and we have separate plant, rectifiers, parallel alternating arcs, and series alternating arcs. Each of these will require an appropriate board, and sometimes more than one of these methods is at work in an alternating station. Auxiliary batteries, feeders, boosters, synchronising gear, dead-load, traction supply, and exciting arrangements, may all have to be provided for, and it would be rash to urge uniformity throughout the business. Nevertheless the fact is that the details are still lamentably weak, and engineers too frequently design or call for a tender for a "switchboard," when what should be asked for is a combination to their own ideas of switches, fuses, instruments, &c. It is upon these lines that American manufacturers have been working for years with success, although their designs do not fulfil English requirements generally, owing to the wide divergence in generation and distribution practice in this country and on the other side of the Atlantic.

Taking the details, everyone will allow that the plug switch has done, and continues to do, good work for currents up to 80 or 100 amperes, so long as double-pole breaking is required. We are rapidly passing to something beyond this, and the difficulty then arises: What switch is thoroughly satisfactory for currents of 150 to 300 amperes at 2,000 volts alternating? This question is not answered in the paper, nor does it seem easy to give a reply. Large numbers of the Ferranti lever pattern are coming into use; but this is a "switchboard," and will not harmonise with any other arrangement. The choice therefore remains with one or two makers, whose apparatus has not yet been in use long enough to make it prudent to speak too definitely upon its merits. Then comes the disputed point—are fuses desirable in the alternator circuits? We think not, and the reasons are ably and clearly expressed in Mr. Andrews's recent Institution Electrical Engineers' paper. A *good* non-return device does everything that is wanted, but it must be of a universal pattern, and generally adaptable. Circuits must have switches and fuses, but there should be no great difficulty in selecting them, because the currents are not generally large, and the switches need not be operated at full load. It is too often forgotten, and is not mentioned in the paper, that alternator switches and fuses may have to break many times the normal current at considerably over the generated pressure. Thus, if one machine is taken off the bus bars when just motoring the pressure across the break of the switch or fuse may be something approaching the sum of the bus bar and machine pressures, due to the change in speed of the machine throwing the phases into opposite sign. For similar reasoning, we think Mr. Blaikie's table of breaking distances of little use, and likely to lead to trouble if adopted, for a switch or fuse of n ampere carrying capacity (or rated value) may have to break a current of many times n amperes, should the circuit it controls develop a short circuit, or the machine in whose connection it is break down and the current come back from the bus bars. In fine, a switch or fuse *must* be capable of dealing with the abnormal conditions due to a fault so far as breaking goes, although it may only be called upon to *carry* its rated current without heating. Again, with continuous currents the inductance effect may be considerable, and this is usually allowed for, but too often it is ignored that capacity on an alternating system may be quite as vicious in its tendency to carry over, to say nothing of the unavoidable risk of opening the circuit at the instant when the peak of the pressure curve is reached.

Oil-pot and protected fuses—such as the Ferranti, Cowan-Still, and Bates patterns—have proved themselves to be thoroughly reliable in careful hands, and are on the whole better designed than most switches. It is a very curious fact that the automatic cut-outs used on continuous current boards should have given so much trouble; one would have thought their design such a simple matter that no fault would be found with them. Yet they have an unhappy knack of flying "off" when a rush of current takes place—a thing that ought only to hold them on more securely. We venture to hazard the suggestion that lamination of the cores and pole-pieces will cure this evil propensity.

With the latter part of the paper there is little need to deal. Everyone will agree with the strictures passed upon ammeters which don't read current, and voltmeters whose behaviour is erratic to the last degree. The instrument

maker, unfettered as regards price, and not limited by "minimum loss of power" clauses, can do fairly well in the matter of instruments, and no one, whose laboratory training has included a course of research work or absolute measurements, need be in a difficulty regarding pressure or current, for the behaviour of instruments reflects the treatment to which they are subjected. In like manner, regulating, and other subsidiary switches, if thoroughly mechanical, give no trouble, but in these days of expensive labour, good fitting, and finish is not ensured by accepting the lowest tender.

One or two points still await ample discussion; foremost amongst these is the best means of providing interchangeability of circuits and machines, commonly known as "hospital barring" or "jack-carding." Within this subject falls "boosting," or individual regulation of high tension feeders. No longer can it be said that the sweet simplicity of the alternating system from pressure-raising devices on feeders is its strong recommendation; either feeder boosters or separate busses at different pressures have to be installed, but no one seems quite settled in his own mind what should be done, or to be able to agree with his neighbour what manufacturers should be called upon to turn out for the purpose.

In closing this review of a useful paper, we would like to strongly urge the claims of all switchboards to be treated in the same manner as other parts of the plant. Frequent inspection, cleaning, trivial adjustments, and small repairs are as necessary as anywhere else, and there is no reserve of x per cent. on the board. Either each detail works, or it does not; yet how often is the board neglected, while boilers, engines, and generators are kept up to the very pink of perfection.

SINGLE v. MULTIPLE GENERATING STATIONS.

The paper on the above subject, prepared by Mr. Snell for the meeting of the Municipal Electrical Association, and reprinted in this issue, is intended, as we learn from the author, merely to serve as a basis for thrashing out the arguments for and against supplying any district with current from one or from several generating stations. The question upon which discussion is invited is one of considerable importance, in view of the steady growth of the supply business, and it is one which the engineers of several of the larger towns have already been called on to decide, and which will, in the near future, have to be examined in connection with the extensions which are in progress in many districts.

The author is in favour of multiple stations, and deals with his subject under the various headings of capital cost, economic generation and distribution, load factor, and possible creation of nuisance.

With regard to what Mr. Snell calls the critical limit of horse-power installed, the opinion of Dr. Kennedy is quoted, that, when one has reached an aggregate power of between 3,000 and 5,000 horse-power, it is as cheap to build a second station as to go on increasing the capacity of the existing one. This statement was made by Dr. Kennedy at a time when the largest generating units in use were, we believe, generally of 300 to 400 horse-power, and it would be interesting to know to what extent this limit would be increased now that much larger units are being used, as, for instance, at Manchester, Deptford, and Bankside, where units of as much as 2,500 H.P. have been adopted. The exact fixing of this limit is, however, not a matter of prime importance, as we believe that in many towns the question of single or multiple stations will have to be answered before even the lower limit of 3,000 H.P. is reached, as a large number of stations are in existence where it would be difficult to erect anything like this capacity of plant, and where, owing to the surroundings of the site, it would not be possible to sufficiently extend the station buildings without going to very great expense in the purchase of neighbouring property.

The question then arises as to whether it is preferable to commence operations on a new site on a much larger scale, and eventually do away with the original small generating station, or whether this first station should be maintained, and a second one erected and worked in conjunction with it. The answer to such a question depends so much on local conditions, such as the relative positions of the old station, of the possible sites for a new one, and of what we may call the centre of gravity of the demand, that we do not see how it can be settled otherwise than by examining each separate case on its merits. In this connection we would draw attention to the assumption made by Mr. Snell throughout his paper, that the one large station will be extra-mural, and the several smaller ones intra-mural. We do not think that this assumption is justifiable, as, in our opinion, the advantages of the multiple station system may often be greatest when these stations are extra-mural, or near the boundary of the town; as in such a case it will frequently be possible to get all, or almost all, the advantages which can be claimed for a single large extra-mural station, and yet be able to supply current on a direct system without undue expenditure on mains; because, if the stations are placed on opposite sides of the town, it is possible to halve the length of the feeders, which only have to come from one side to the centre, instead of having to traverse the town from one side to the other.

The same conditions hold good when we consider the question from the point of view of economy in generation and distribution, as if the station or stations are in the central parts of the town, or, to use Mr. Snell's words, are erected on the mains they are to supply, so that the distribution losses are small, there will almost certainly be compensating disadvantages in the extra cost of carting coal and ashes, in getting condensing water, and in the increased chances of trouble from the nuisance question. On the other hand, if the station or stations are out of the town or near its boundaries, it will often be possible to find two sites which will permit of moderate distribution losses, whilst at the same time offering facilities for dealing with coal and ashes and for condensing. Of course, there will be cases when one large station will give the best results; but on this point it is, as we have already said, difficult to generalise, and our remarks are made rather to draw attention to the fact that even when several stations are used to serve a town, it may be better to erect them practically outside the boundaries, rather than on the mains they are to supply.

We cannot quite understand Mr. Snell's remarks about the load factor, and do not see how he can expect a better one with several stations than with one. If the term load factor is used in the ordinary sense of the ratio of the actual average output per hour to the maximum output of any hour during the year, it will not be changed whether there be one or more stations; and if the factor referred to be a plant factor, we should expect the advantage, if there be any, to be on the side of the single station.

With regard to the nuisance question, a station situated centrally is always at a disadvantage, and we do not agree with the author of the paper that vibration and smoke nuisance can so easily be dealt with in a satisfactory manner. It is wonderful how keenly sensitive to vibrations the neighbours of a central station become, if they think there is the slightest chance of getting anything out of a supply company; and with regard to the smoke nuisance, we have for some time past had convincing evidence in London that Mr. Snell is somewhat optimistic when he says: "One may confidently say that in these days there are few of us who would care to admit that our stations would be complained of from this point, and with careful stoking and management, the smoke nuisance is more visionary than real."

The question of how best to extend, so as to be able to supply current in greater quantities, and over a larger area, is one which gives plenty of scope for discussion, and we hope that some of the municipal engineers who have lately carried out such extensions, or have reported on the best way of doing so, will communicate to the meeting their reasons for adopting the methods they have recommended; as, notwithstanding the local differences which must exist between one district and another, all such information must be of great use to their fellow engineers who may have to consider this question.

Presentation.—Mr. F. T. Paynter, shift engineer at the Windsor electrical installation works, has been presented with a marble timepiece and a pair of ormolu ornaments by the directors and staff on the occasion of his marriage.

REVIEWS.

A Text-Book of Applied Mechanics. Vol. II. By Andrew Jamieson. London: Griffin & Co. 1897.

This is one of a growing family of books whose origin is based on the idea religiously held by every engineering professor, that he must protect the morals of his own flock by specially preparing a text-book for their use. Anyone who has had the misfortune to pay school bills knows how the pedagogues at one school play into the hands of those of other schools, by discovering virtues in new grammars. Curious, is it not, that a dead language like Latin is so much alive that new grammars can be poured forth about it, whereas there is no grammar at all of Anglo-Saxon slang, so very much alive? Some such thoughts as these attack one on the appearance of a new book of mechanics. We have paid for so many improved grammars and English histories, that we feel sorry for those who have got to buy all the mechanical text-books. But having said this, we don't propose to say much more against Prof. Jamieson's book. We can forgive a good deal to a man who, being a professor, resolutely refuses to use the word poundal in his pages. We have searched diligently, and lo! we have not found it.

We would also desire to compliment the author on the choice and method of the examples he has employed, notably where he shows how the tension in a rope is so much greater than the weight it is lifting when acceleration is in progress. We incline to think that rope tensions are often treated entirely from a static standpoint, with perhaps liberal margins, a very undesirable thing to do in face of the rapid accelerations in deep pit work and high buildings' elevators.

The first part of the book concludes with a description of many varieties of engine governors and other examples of centrifugal force and machine balancing. Part IV. deals first with the graphic statics of framed structures, and is about as clear an exposition of this art as we have seen. Part V. deals with the stresses in shafts and beams and their deflections, and Part VI. with hydraulics and hydraulic machinery and refrigerating machines, which seem to be a little out of place and more suitable for special treatises.

Altogether, however, this is a very common-sense sort of book. It is intended for students advanced beyond the elementary stage who may or ought to be supposed to know that, strictly speaking, the term *cold* is intended to convey the idea of more or less deprivation of heat. Cold is simply a relative form of heat, and were we a professor with an abnormally developed sense of the supreme importance of definition we should *lodge* a complaint against our author for some of his language. On page 360, speaking of refrigerating machinery, he has the temerity to speak of brine as acting as a transmitter of cold. Of course, everyone will perfectly understand what is meant, and we think no one will even be led astray, but there be many will have his blood for speaking of cold as an entity. Our complaint of the account of refrigeration is that it is a mere description, there are no figures or dimensions to enable a student to make a calculation of what can be done with a machine, nothing as to the physical properties of the materials employed in refrigeration and what can be accomplished with them. We do not see why this mere descriptive section has been added to the book.

Electric Wiring and Fittings Details Book. By W. Perren Maycock. London: Whittaker & Co.

This book is intended for firms connected with the electric wiring business, its object being to afford an expeditious, convenient, and methodical means for noting down particulars concerning both the wiring and fittings of any electrical installation, on any wiring system. It consists of little more than a mass of sheets set out with columns, for the purpose of taking proper note of the required positions of lights and other fittings, the description of fittings to be put up, and general remarks regarding same. We observe the sheets are perforated for tearing out; this is perhaps as well, for the book is rather bulky. The idea of the author is a good one, and the book may be of service to some engineers and wiring contractors. There are two pages of directions for use, so that the user may understand what he is about.

THE MUNICIPAL ELECTRICAL ASSOCIATION.

The third annual Convention was opened on Wednesday morning at the Royal United Service Institution. The programme, which we published in our issue of May 27th, showed that the public proceedings were to last three days. Of the importance of the papers to be presented there can scarcely be a diversity of opinion. The range of subjects is probably not so wide, and they are probably more specialised in their treatment than was the case at the last Convention in London. They mainly deal with the essential features of municipal electricity supply from the engineering point of view, and were naturally expected to evoke considerable discussion.

A large number of municipal engineers and a moderate sprinkling of other members of the electrical engineering profession were present when Mr. A. H. Gibbings, the President, rose to deliver his Presidential Address. It is scarcely necessary here to dwell in detail upon the points raised by the President. He referred with some amount of pride to the educational and the stimulating effect that their former conventions had created, and he considered that the rapid progress that had been made by municipalities in electrical undertakings during the past two years was due, in a great measure, to the work of the Municipal Electrical Association. He dwelt at some length upon the constitution of electricity committees, and suggested a divided responsibility, by forming electricity sub-committees. The future developments of electricity supply were noted, and the address concluded by some suggestive remarks on the subject of standardisation of plant. He pointed out that while many were agreed that some form of standardising was necessary, there was a diversity of opinion as to what the respective standards should be. The co-operation with other and kindred societies for the purpose of dealing with some of the special subjects he had raised was insisted upon with some force.

The next business of the meeting was to hear a paper read by Mr. Councillor Hesford, chairman of the Electricity Committee of the Southport Committee, on "The Management of Electrical Undertakings." The paper is published in full in another part of this issue, and it is not proposed to do more than give the principal points raised in the discussion. Mr. Faraday Proctor (Bristol) raised some interesting points, the chief of which were, that it was always advisable to engage an engineer, who was to run a station, from the the commencement of building operations. In the case of a small station, he thought it best to employ a consulting engineer, because it would not be possible to pay an adequate salary to a resident engineer who was capable of laying down plant; at the same time he urged that a resident engineer should be there all the time. The question of dividing the engineering and secretarial work was next brought forward. Mr. Proctor's view seems to be that the mere account work should be done by a separate department, but that the secretarial work should be done by the engineer. Mr. Councillor Skinner, of Hull, referred to the practice relating to accounts in that town, and said they all passed through the hands of the treasurer. Mr. Bromley Holmes (Liverpool) thought the engineer's duties should cease when the units were certified in the consumers' books. Mr. Jackson (Newcastle) asked if it would not be possible to get municipalities to make their accounts more in accord with the Board of Trade form, so that it would be possible to compare the accounts with those of companies. He referred to the practice in some Continental stations of employing a mechanical engineer, an electrical engineer, and an outside engineer. Generally speaking, the outside man in this country was not paid well enough. Mr. Wordingham (Manchester) thought that the paper dealt with the policy rather than the management of stations. His views on the employment of a consulting engineer were almost similar to those of Mr. Proctor. In his opinion it was unnecessary to duplicate

generating plant; it would be difficult to duplicate distributing network, but feeders could more easily be duplicated. He considered that the accountant's portion of an undertaking should be entirely separate from the engineering part. The engineer should have a voice in the financial management, but actual account work should be entirely separate. Mr. Boot (Tunbridge Wells) raised an interesting point about the reserve fund, and Mr. Robert Hammond having addressed the meeting, mainly on the reserve fund question, Mr. Hesford briefly replied.

The meeting then proceeded to discuss Mr. Blaikie's paper on "Switchboard Apparatus," the paper being taken as read. Mr. Wordingham thought there ought to be no inflammable material in connection with a switchboard, and did not admit the difficulty of making it decent looking under such circumstances. It was impossible to lay down any definite length of break in a switch according to current, because a good deal depended on the design of the switch, and the speed of the break. Fuses were necessary in high pressure stations, but in low pressure works they did more harm than good. He thought there was room for some convenient and cheap means of signalling between the switchboard and the engines. Mr. Andrews (Hastings) after referring to automatic cut-outs, and pointing out that electrical engineers did not like them, because they were unreliable, said that a fuse on an alternator was useless, and a great source of danger. Mr. Robert Hammond expressed his surprise that wooden switchboards abounded in Germany. He pointed out that it was important not to put an inflammable board on a flammable floor, and he advocated a space of at least 4 feet between the back of the board and the wall. Mr. Rider (Plymouth) spoke of the danger of the field switch being on the dynamo instead of on the board. With regard to the space at the back of the switchboard, he thought the best arrangement was to have no back at all. Mr. Quin (Blackpool) and Mr. Evershed made some remarks, and the meeting passed on to rapidly discuss Mr. Jeckell's paper.

CORRESPONDENCE.

Prof. Carus-Wilson's Paper.

As it would appear, judging from to-day's issue of a contemporary, that I did not make my meaning plain—even to the author of the paper—at the discussion on Prof. Carus-Wilson's paper on the 26th ult., I beg leave to supplement it by a few remarks, which will, I hope, explain more clearly my reasons for disagreeing from Prof. Carus-Wilson's figure No. 5.

I may say at the outset that I quite understood that Prof. Carus-Wilson's remarks related only to the shunt motor, but in view of the diagrams in fig. 4 and the conclusions deduced on page 8, the inference may have been drawn by some that the error was equally negligible with the series motor; and the curves in fig. 5, which show the series motor covering the distance in *less* time than the shunt motor, may strengthen this wrong impression.

It only needs pointing out for it to be seen that fig. 5 is not a practical case; for, if we have a locomotive to draw our train, we cut down its weight to nothing more than that necessary for the requisite power; while, if we have motors on the bogies, we cut down their number to the minimum consistent with the necessary power and space available, *i.e.*, if we at all value our peace of mind. In either case the limiting value of the initial acceleration is determined solely by *adhesion*; and in comparing the shunt and series motors Prof. Carus-Wilson has departed from this assumption.

Imagine the initial slope of the series curve (fig. 5) made the same as that of the shunt curve, so that the series curve falls away from the straight line, *o a*, on reaching a speed of about 10 feet per second, and it will be evident that the current for the series motor would be required much longer at its maximum value, and much longer at its final value, than shown; also that the time required to cover the 500 feet would then be much greater for the series than for the shunt motor.

Imagine, further, that the level part of the shunt curve (representing constant acceleration) was lowered, so that the distance was covered in each case in the *same* time, and I think we shall find there is not much difference between the energy required in the two cases.

The example I cited from Mr. Short, as well as that which had occurred in my own work, and my deductions therefrom, were based on an equal initial acceleration in the two curves compared. In the latter case both curves were for the same final speed and, in departing from this, Mr. Short has, I venture to think, rather given his case away so far as energy consumption is concerned.

My remarks were intended to show—not that Mr. Short's apparatus for effecting it was perfect—but that the principle of carrying the acceleration at its full value right up to the point when the maximum speed of the train is reached, is a good one, and this, I venture to think, has yet to be disproved.

Prof. Carus-Wilson's own conclusions and his curves in fig. 4 are, in fact, based on this assumption, though he does not explain how he proposes to obtain it with a series motor.

Hoping I have made this clear, and that you will be able to find space to insert this letter.

A. M. Taylor.

Electricity (?) direct from Water Power.

If Herr Josef Popper has had the notion referred to in your note on page 731 of your issue of May 27th, on his mind since 1895; it must have been a heavy burden to it. A normally vigorous one would have tossed it off long ago. Why, in all that time, hasn't he put the idea to a practical test? Or, stranger still, why, at least, hasn't he put it through the mathematical grinding mill—the mill that grinds bright ideas so exceeding small—and, as others have before him, seen it puff away in thin air? *That* wouldn't require three long years of patient meditation; in fact, it is a more simple process than putting pen to paper to describe the grand idea.

The same brilliant inspiration visited the writer some years previous to 1895 in much the same way no doubt as it has lighted round on many others before and since. But sad to relate, it did not behave so congenially to him as it has to Herr Popper. In fact, after the first joyful welcome of what appeared so charming a guest; want of confidence in his credentials, or his claims to be all he seemed, grew up with such alarming rapidity, that a few short hours terminated the intercourse.

He is fortunate, at last, to have found such a staunch friend as Herr Popper, for really, his character, so fair-seeming at first acquaintance, has such an uncomfortable habit of falling to pieces upon closer investigation, that his friendships, if many, are all too brief. Clearly Herr Popper must be one of those delightful but erratic souls, who, hospitable to a fault, would scorn to harbour a suspicion of an agreeable guest.

The crux of the difficulty in realising the promise of this idea, lies in the implacable fact that 100 million magnetic lines of force must be cut through per second by a conductor to generate at its ends a potential difference of 1 volt. We come against the same old boundary fence that limits our aspirations in so many other ways. For the greatest practical value of the magnetic induction attainable falls short of 20,000 lines per sq. cms. Therefore, to generate 1 volt per centimetre length of conductor, the velocity of the conductor across the magnetic field of such strength must be 5,000 cms. per second, equivalent to about 170 feet per second. To obtain this velocity, in a jet of water for instance, would require a head of over 400 feet.

The transverse resistance of a jet of water 1 centimetre through depends mostly upon the area of the contacts. It is very considerable at the best; and there is only 1 volt pressure available both for this and the external circuit. Current is likely to be a wanting quantity under these circumstances. Suppose we increase the velocity, and leap with vaunting ambition to, say, 1,000 feet per second, needing a water head of 15,000 feet, or pressure of over 3 tons per square inch, and therefore quite outside the bounds of practice. It gives us a meagre 6 volts for a centimetre jet, which, by the way, would be passing an enormous quantity of water, and could scarcely be constructed to stand the wear and tear.

There is no question of multiplying the jets and placing

them in series, for the internal resistance increases them in the same proportion as the volts. Further, there are practical difficulties in the way of insulating the jets which are insurmountable. It would be a sufficiently onerous business to insulate one jet; in which there would in any case be considerable leakage up and down the stream, and thence across it outside the influence of the magnetic field. To insulate many jets, many pipes, many reservoirs, many mountain lakes and river sources—well, no thanks! the idea is a little too appalling!

All the above applies with even greater force to the proposal to use gases. At most 20 volts might be obtained across a jet 1 centimetre through, and a resistance inexpressible in megohms! May our quondam guest have a long and contented residence in Germany!

James Whitcher.

Nottingham, *June 3rd.*

Honour to whom Honour is Due.

I have read with interest your article "Honour to whom Honour is Due," at p. 685 of your esteemed journal. I may be allowed to add in connection with this subject that Prof. Holtz has proved up to the hilt at p. 686 (A.D. 1883) of my "Centralblatt für Elektrotechnik" that he invented at a much earlier date the machine now ascribed to Mr. James Wimshurst. If the Council of the Royal Society propose to distinguish Mr. Wimshurst on account of his machine, the ignorance of the history of science displayed by that eminent body is to be deplored.

Uppenborn.

May 31*st*, 1898.

[Mr. Rollo Appleyard in his letter in the ELECTRICAL REVIEW, May 27th, considers that we have been scarcely fair to James Wimshurst in our article dealing with the question of priority of invention of the Wimshurst influence machine. The above letter shows that we are at least in agreement with so high an authority on the history of electricity as Uppenborn. We may also quote from Prof. Schaffers, of Louvain, in his recently-published work, "Essai sur la theorie des Machines Electriques a Influence," where he says, "De fait, en 1876, Holtz avait clairement decrit le dispositif particulier aux machines Wimshurst secteurs radioux et conducteurs à balais." Speaking of the machine illustrated in our figure, p. 685, Holtz said in 1876 (*Nachrichten von der kön Ges. der Wissenschaft Göttingen*) that the before-mentioned machine may be made self-exciting by covering the plates with small radial strips of tinfoil and replacing the combs with brushes or springs. Mr. Rollo Appleyard in his letter carefully avoids pointing out in what respect the Wimshurst machine differs from the machine invented long before by Holtz. The evidence we have cited appears to show that there is no difference in any essential electrical detail. No one thoroughly acquainted with the subject will venture to say that machines of Varley, Tœpler, or Kelvin come into the same category. It is useless for Mr. Appleyard to say the machine of Holtz did not possess the five "simultaneous characteristics" of the Wimshurst machine. The machines, being identical, must both possess five or any greater number of "simultaneous characteristics." Mr. Wimshurst deserves the credit of having introduced to physicists in this country a very valuable electrical machine, which otherwise would probably have long lain buried in obscure German publications. It is his misfortune that, without his knowledge, he had been anticipated, but such misfortunes are not usually considered a justification for depriving the first inventor of the credit which is his due.—EDS. ELEC REV.]

The Chelmsford Fatality.

Another victim to the use of high tension alternating currents!

Everyone connected with the electric light industry must be sincerely sorry at the sad calamity.

As a rule, sooner or later, fatal accidents occur at most stations where such a dangerous system to employés is in use.

Recognising the dangers connected with it, you would naturally expect that in planning and arranging for the safety of the workmen, some common-sense means would be adopted to prevent the possibility of fatal accidents.

What are the actual facts? Instead of placing transformers in a special building, with plenty of room and ample daylight—which are an absolute necessity—they are generally fixed under the pavement in limited space, and to get to them the workmen have to grope their way down iron ladders or iron projections to a dark chamber.

I consider erecting small dark sub-transformer stations under the public pavements leads to accidents, and should be discontinued.

If not, as time goes on, more shocking fatalities will occur, with the usual verdict of accidental death to follow.

I know, from practical experiments made over 14 years ago, during wet weather, and while wearing wet boots, how quickly you can get shocks, but I naturally took care that the experiments I made were with continuous currents of about 400 volts pressure.

A transforming sub-station should not be built without having easy access to it, plenty of daylight, a good dry wood floor, and over it vulcanised rubber sheets of substantial thickness.

I recollect a few years ago explosions in electric light conduits were rather frequent in London, and I noticed about that time you had a short article in the ELECTRICAL REVIEW referring to them, and asked if anyone, from their experience, could suggest a cure. On that invitation I related my early experiences, and suggested (having laid the first underground mains for electric light under the London streets) that in the absence of good ventilation in the conduits of the companies affected, if they would remove the lids of the service connections every morning, the explosions would cease.

The hint I saw was very quickly acted on, and the explosions—well, you never hear of them now.

I hope my suggestions *re* transformer sub-stations will also be acted upon. If so, I am quite certain it will, in the future, be one of the means of assisting to stop the cause of recent fatal electric shocks, where high tension alternating currents are used.

A. L. Fyfe.

The Parliamentary Committee on Electricity Supply.

In the revised report of the Joint Committee on Electrical Energy (Generating Stations and Supply) just issued there appears two clauses which were not in the proof which was handed out just before Whitsuntide, but which are of such great importance that I venture to ask you to call attention to the fact in your next issue.

The clauses to which I refer are as follows:—"In connection with this question of purchase under section 2 of the Act of 1888, evidence has been given to the effect that with a view to secure in London one and the same time for execution of the powers, the Board of Trade have in some cases imposed upon undertakers a less term than 42 years within which they are liable to be purchased."

"The Committee suggest that if the full period of 42 years is not granted, and if a substantially shorter period is imposed by the Board of Trade, the terms of purchase should in each case be reconsidered."

Syd. Morse.

The Electrical Engineers Volunteers.

A friend of mine on hearing that the uniform of the Electrical Engineers Volunteers was to be the same as that of the volunteer battalions of the Royal Engineers, at once gave up all idea of joining the corps, although he was very keen on being a member when he first heard that such a regiment was to be enrolled. He is now making arrangements to join the Yeomanry Cavalry, as, to use his own words, he "will then be able to walk through the public streets in uniform without being insulted and his friends will not be ashamed to speak to him."

Whether his views are right or no, there is no doubt that the great majority of the British public always associate the red coat with that useful but much maligned body of men, viz., the Militia, and I have known many young fellows join the Artillery, although the work is harder than that of a

rifle corps, for the simple reason that the latter have such a prominent uniform.

Thinking that probably my friend's case is not a solitary one, I would beg to suggest to the proper authorities that an alteration might be made to the uniform, and as no doubt it is now too late to do away with the red tunic, might not the facings be such as to be entirely different from any other regiment.

There is no doubt that the Electrical Engineers will be one of the crack corps of our volunteer army; the men no doubt mean to be, and the profession expects them to be, and such being the case the War Office might give them a uniform that would proclaim to all and sundry the regiment to which they are proud to belong.

Raw Recruit.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending June 7th, 1897.	£	s.
Adelaide	11	0
Amsterdam	75	0
Antwerp. Elec. fuses	43	0
Baltimore. Teleph. mat.	22	0
Buenos Ayres	83	0
Calcutta	690	0
Colombo	20	0
Durban	341	0
Kobe	381	0
Madras	26	0
Melbourne	44	0
Perth	116	0
Rotterdam	31	0
St. Petersburg	28	0
St. Pierre, N.F. Teleg. cable	19,050	0
Shanghai	143	0
Sydney	55	0
Yokohama	381	0
Total ...	£21,540	0

Week Ending June 7th, 1898.	£	s.
Aden. Teleg. mat. ...	600	0
Alexandria. Teleph. mat.	305	0
Amsterdam	200	0
Auckland	126	0
Bangkok	405	0
Bombay...	584	0
„ Teleg. mat. ...	61	0
Buenos Ayres	264	0
Calcutta...	233	0
Cape Town	70	0
Copenhagen	52	0
„ Teleg. cable	5,600	0
Durban	2,609	0
East London	98	0
Flushing	60	0
Genoa	637	0
Gibraltar	60	0
Gothenburg	44	0
Hamburg	42	0
Launceston	10	0
Lisbon	793	0
Lyttleton	245	0
Mauritius	35	0
Melbourne	98	0
Monte Video	157	0
Ostend	36	0
Perth	152	0
Stockholm. Teleg. wire	1,343	0
Sydney	85	0
Wellington	732	0
Yokohama	23	0
Total ...	£15,759	0

Foreign Goods Transhipped.

	£	s.
Lisbon	2,000	0
New York ...	83	0
Total	£2,083	0

Bankruptcy Proceedings.—On 3rd inst., at the offices of Mr. J. C. Clegg, Official Receiver, a meeting was held of the creditors of John Henry Dewhurst and George Longden, who traded as John Dewhurst & Son, electrical engineers, 68, 70, and 72, Attercliffe Road, Sheffield. Mr. J. E. Wing represented the debtors. The Official Receiver stated that the receiving order was made on May 12th on a creditor's petition. The statement of affairs showed £1,938 2s. 10d. owing to unsecured creditors, and £205 10s. 11d. liabilities on accommodation bills, making the total liabilities £2,143 13s. 9d. The only assets were some doubtful and bad debts which were estimated at £100. Some time prior to October last the debtors carried on business in Attercliffe Road as partners, though originally neither of them took any capital into the concern. In October the business was converted into a limited company, an agreement being made between the parties that the company were to take to the business and to pay £5,000—£4,000 in shares, and £1,000 in cash on October 4th, 1902. The company were to be entitled to possession as from October 1st, and in accordance with the agreement the concern was transferred to them a few days later. The shares had not been issued to the vendors, and he believed there had been some subsidiary agreement in relation to the £1,000 under which certain payments had been made, or were alleged to have been made on behalf of the vendors to enable them to meet some of their outstanding liabilities. He did not thoroughly understand this matter yet, and could not get a proper explanation from the debtors. The agreement provided that the liabilities of the vendors should be paid by the company, but certain of the liabilities in respect of money-lending transactions were not taken over by the company. The matter would, of course, require further looking into. Perhaps there might not be any great advantage in following it up, because he understood that there had been no further capital brought into the company except a sum of £1,000, part of which was applied in payment of the expenses of the formation of the company. One thing was pretty clear that by the agreement the debtors transferred all their assets to the company, and left themselves with outstanding liabilities to the amount of something like £2,000, and no means of meeting these debts. That was the position they were left in under the agreement, and, of course, the debtors soon began to realise the difficulty of their position. After struggling on for some time they executed a deed of arrangement, but one of the creditors who did not consent to the arrangement presented a petition, and the receiving order was made. As far as the separate estates of the debtors were concerned the only asset in each case was household furniture. It was clear that the debtors were largely insolvent in October last. They said they were not aware of this, but subsequent investigation proved such to be the fact. Mr. Wing said with regard to the £1,000 cash, the debtors were owing the Birmingham District and Counties Bank about £2,500 when the company was formed, and they also owed money to moneylenders. It was arranged that the £1,000 should be advanced by the bank for the purpose of providing means for the bills of the moneylenders to be met—for the purpose of warding them off a bit. When the bank stopped payment the the company was wound up, and the debtors made bankrupt. The company was only in existence about four months, from October to February. The question of the appointment of a trustee was considered, and the estate will be dealt with by the Official Receiver. Mr. Wing explained that he was acting for some of the creditors of the company, and the whole matter would be most thoroughly investigated.

Business Sold.—The business of Kerby Bowen, Limited, electrical launch builders at St. Helen's and Cowes, Isle of Wight, was disposed of by auction on Wednesday last week, by Messrs. Perkins & Sons, by order of the High Court of Justice (Chancery Division), and realised £700.

Campbell v. Benjamin Jacobs.—This action, heard last week at the Glasgow Appeal Court, was for recovery of the contract price for fitting up an installation of electric light. The contract controlled the price so far as workmanship was concerned, but the price of the material was not included, although an estimate was appended to the offer. The defender challenged certain items as excessive. The Sheriff Substitute (Strachan) allowed a proof, and on appeal the Sheriff adhered.

Clayton Air Compressors.—During the months of February, March, and April, the Clayton Air Compressor Works, of New York, sold 19 air compressors for operating pneumatic stone tools, chipping and calking tools, air hoists, &c.; nine air compressors for moving and elevating acid and chemical solutions; four air lift pumping plants were installed and placed in operation; three air compressors were furnished to rubber works for removing hose from mandrels, testing hose and inflating tyres; one compressor was supplied for the pneumatic transmission of messages; two for oil burning plants; three for racking off beer in breweries; one for spraying brick in the process of manufacture; and six for unusual applications of compressed air power. In addition to a number of air compressors furnished for domestic use, four were exported to Europe for operating pneumatic shops plants. The above notes show the wide range of applications of the Clayton compressor.

Dermatine.—A pamphlet giving a short account of the discovery and manufacture of India-rubber and gutta-percha, and a description of the "special characteristics and qualities of dermatine as superior to either," has been issued by the Dermatine Company, Limited, of 95, Neate Street, S.E. Prices and particulars are given of the patent dermatine machine belting, circulating valves, sheet and insertion, mats, and dermatine is recommended as an insulator in electrical work.

Dissolution of Partnership.—Messrs. F. M. Prockter, A. Turner, and H. F. Clough, carrying on business as electrical and general engineers, at 10A, Virginia Street, Southport, under the style of Prockter & Co., have dissolved partnership by mutual consent.

Electric Power for South African Mines.—A South African correspondent of the *Financial News* says that it has been suggested that certain mines which find themselves short of water should avail themselves of the electric power supplied from Brakpan. Thus they would be enabled to close down their steam plant and to do with very little water. The May Consolidated Gold Mining Company is already in negotiation with the Rand Central Electrical Supply Company, and it is likely that arrangements will be shortly made by which the May's mill shall be driven by electric power.

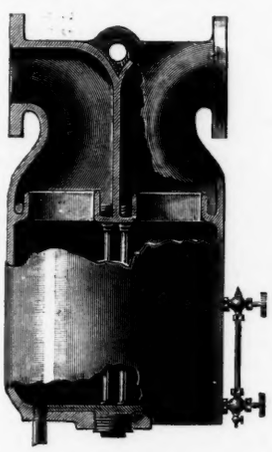
Electric Tramways.—The Brush Electrical Engineering Company has issued two pamphlets reprinting in first class manner descriptions which have appeared in some of the technical papers of the Kidderminster and Stourport electric tramways and the Dover municipal electric tramways. It is well known that both of these are lines for the equipment of which the Brush Company has been mainly or largely responsible.

Exhibitions.—Messrs. W. H. Willcox & Co., are exhibiting a general collection of engineers' tools and engineers' stores, also lubricating oils, at the various agricultural shows which are being held at Portsmouth, Birmingham, and King's Lynn, during this month; and at Lincoln, Leeds, and Tunbridge Wells during July.

Fined.—On Monday at the Wolverhampton (County) Petty Sessions, E. J. Pennington was fined £2 10s. and costs for driving a motor car at a furious rate. Three grooms who gave evidence, respectively stated that the car was proceeding at 20, 25, and 30 miles an hour. The bench commented upon the public danger. On the previous Friday the same defendant was, in another Court, fined £3 and costs for each of various breaches of the Light Locomotives Act (total £18 15s. 8d.) committed on April 23rd.

Forthcoming Book.—Messrs. Seeley & Co. will shortly publish a brief popular account of "Wireless Telegraphy," by Mr. Richard Kerr. The methods devised by Mr. Preece, Signor Marconi, Dr. Oliver Lodge, and others who have worked in this direction will be explained in popular style.

The Hoppes Steam Separators.—The drying of steam by discharging it of water has lately been attracting a good deal of attention. The annexed illustration represents a simple form of separator made by the Hoppes Manufacturing Company, of Springfield, Ohio, which affords a very considerable volume for the collection of water, and will, therefore, provide for a considerable flush of water, and at the same time it provides a cross section about ten times the steam pipe area. Suitable water channels are provided to catch the drip and flow of water down the sides of the vessel and prevent its re-entrainment. A glass gauge shows the amount of accumulation,



and a trap provides for final discharge. It is important that steam traps to separators should be of good size in order to allow the rapid discharge of sudden flushes. The Hoppes separator is symmetrical, and no mistake can be made in fixing it, as steam can enter either side indifferently. Its construction, while sufficient, is simple, and it should give a minimum of obstruction to the flow of steam, an item apt to be overlooked in the construction of separators, on what may be termed the steam worrying system. A somewhat similar apparatus is provided for fixing in vertical lengths of pipe.

Lists.—We have received from Messrs. Parvillee Frères, 29, Rue Gauthey, Paris, an illustrated list of their manufactures of electrical porcelain. The list deals more particularly with insulators for telegraphic, telephonic, and overhead traction work.

Messrs. C. E. Billin & Co., of Marquette Buildings, Chicago, send us a pamphlet (March, 1898) on their machinery and supplies for mines and mills. The firm are engineers, purchasing and forwarding agents, and the list contains special lines of a large number of American manufacturers.

McDonald v. Clement.—At the Glasgow Court of Sessions last week the settlement was intimated of an action by Robert M. M'Donald, electrician, Davos House, Strathtay, against Hugh Sprott Clement, manager of the British Patents Company, 121, West Regent Street, Glasgow. The pursuer sought reduction of a letter written by him to the defender in July, 1893, in which he assigned to the defender one twenty-fourth part of his interest in an invention relating to primary electric batteries. The pursurer said that the letter was written in consideration of the defender having found a purchaser for the patent, but that the defender failed to carry through the sale. The defender raised two actions against the pursuer, in which he sued for payment of the value of his interest. All the actions have now been settled extra judicially.

Newport Electric Light Association.—This association has opened premises at 55, Commercial Road, Newport, as electricians and mechanical engineers. Mr. J. L. Davies, who has had a varied experience in electrical work, is the manager. He was for two years in the employ of the Brush Electric Light Company, and three years at the Edison Central Depôt, New York, U.S.A., and has had three years local experience in wiring and other work.

Parliamentary Bills.—In the House of Commons on Monday, the following Bill received from the Lords was read a second time:—Blackpool and Fleetwood Tramroad (Tramway Extensions). The Great Northern and City Railway Bill was also read a second time. It is stated that the Royal assent has now been given to the Eastern Telegraph Company's Act, 1898, which has been promoted by that company in Parliament for the conversion of the existing 6 per cent. preference shares into 3½ per cent. preference stock, and for other purposes. The final dividend on the 6 per cent. preference shares for the quarter ended June 30th will be paid on or about July 1st next. The dividend on the new 3½ per cent. preference stock will accrue as from July 1st next, and will be paid quarterly on the same dates as those on which the dividend on the 6 per cent. preference shares has hitherto been paid. The existing transfer books are to be closed on June 15th, and the transfer books for the new stock will be opened as from July 1st next.

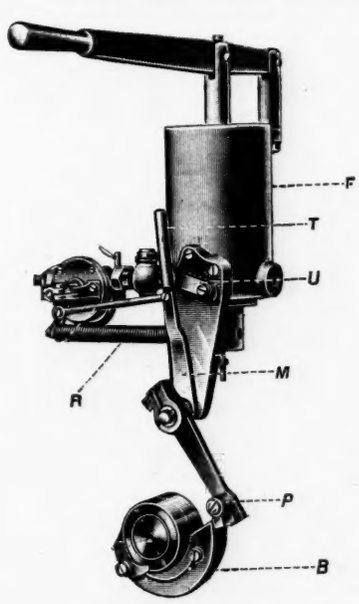
Partnership.—Mr. J. T. Niblett having resigned his position as general manager to the Lithanode Electric Storage Company, announces that he has entered into partnership with Mr. Malcolm Sutherland, and in future the firm will trade under the name of Niblett & Sutherland, electrical engineers, 61, Chandos Street, Strand, W.C.

Personal.—We understand that Mr. H. H. Hall, A.I.E.E., has voluntarily resigned his position as engineer to the Electric Lighting and Fittings Corporation, Limited (late John Haynes Lighting Company, Limited), in order to join the Walsall Electrical Company, Limited, which firm he now represents at 6, Central Chambers, 17A, South Castle Street, Liverpool.

Smoke Nuisance.—On Wednesday last week the London Electric Supply Corporation, Limited, of Stowage Wharf, Deptford, were summoned at Greenwich, at the instance of the Greenwich District Board, for having allowed black smoke to issue from a chimney on two successive days, in such a quantity as to be a nuisance. Mr. J. Spencer, clerk to the Board, prosecuted, and a representative of the Company having pleaded guilty, the magistrate imposed a fine of £10 and 2s. costs in each case.

South African Electrical News.—The *British and South African Export Gazette* has the following items of electrical interest in its June issue:—A shipment of electrical material and machinery, valued at £3,000, has been consigned to Port Elizabeth by a New York firm. The electrical installation supplied to the Angelo and Driefontein mines is a three-phase plant, including engines of 450 H.P., and was manufactured by Messrs. Brown, Boveri & Co., Switzerland. The Town Council of Kingwilliamstown is considering a scheme for the electric lighting of the borough. The Queenstown (Cape Colony) Municipality has also an electric light scheme under consideration. The Durban Town Council has recently ordered two additional miles of cable and a condenser. A telephone installation has been ordered for Bulawayo. The Natal Government estimates for the year ending June, 1899, make provision for additional telephone plant to the extent of £4,900. Electrical lifts for the new premises of Messrs. Thorne, Stuttaford and Co., Johannesburg, are on order with Messrs. R. Waygood and Co., Limited. An electric elevator, manufactured by Messrs. Easton, Anderson & Goolden, has been supplied to the Luipaardsvlei gold mine. The present air compressor pumping plant, which was manufactured by Messrs. J. Cameron for the Langlaagte Deep gold mine, is shortly to be replaced by an electrical pumping installation manufactured by Messrs. Riedler & Co.

Starters for Gas Engines.—In Mr. W. H. Booth's recent article in our columns on "Starters for Gas Engines" he advocated the use of a small starting engine for the purpose. Mr. Joseph



Edmondson, of Bradford, claims to have effected this in another way, namely, by means of the Edmondson & Dawson patent starter. This is claimed to give an initial impulse, automatically proportioned to the requirements of the engine at the time. The advantages claimed

for this starter arise from three features, viz.:—(1) The initial impulse being delivered on a piston *already set in motion* (by the compression of the charge by the pump) is cumulative in its effect. In other words, the primary inertia of the piston having already been overcome, the influence of the initial explosion upon it is much greater than it otherwise would be; (2) The initial charge being compressed by the pump, the initial explosion is proportionately more powerful than in any starter working at atmospheric pressure. Owing to these two features, the initial impulse carries the running well over the first cycle, and the piston is moving steadily when it receives the *second* impulse. (3) At the slow speed of starting by any self-starter the proportions of gas and air in the charge drawn into the cylinder is frequently not ignitable by the tube; hence the extreme difficulty of starting an engine by a single initial impulse. In the Edmondson-Dawson starter this difficulty is said to be entirely removed. It injects a flame into the midst of the charge and will therefore ignite a mixture so badly proportioned that the tube would fail to fire. Hence by this starter ignition is certain, and successive impulses are given to the piston—the engine runs in spite of the temporary failure of the tube to fire the charge—and thus the speed is gradually but surely got up to point at which the tube takes up the firing and the starter may be put out of gear. The action is as follows:—The engine being set on the "explosion stroke" with the gas cock turned on, and with the crank a little behind the top centre, the starting cam, B, having the square stud, Q, resting on its nose; the exhaust valve of the engine being set open; a charge of explosive mixture (gas and air) is pumped into the cylinder by the pump F. When the cylinder is filled with explosive mixture the exhaust valve is closed. The pumping being continued, the charge is slightly compressed till it propels the piston slowly and moves the cam, B, forward (clockwise) till it drops the roller, P, into the gap of the cam and releases the lever, M, the spring, R, rotating the plug of the ignition valve, towards the right, ignites the charge in the cylinder and propels the engine. If the pumping be still continued so as to keep the connections between the pump and the cylinder full of explosive mixture, the revolution of the cam, B, by opening and closing the ignition valve and exploding the charge at the proper times, will give successive impulses to the piston, increasing its speed until the ordinary igniting apparatus takes up the firing and the engine is effectually started. The starter is then thrown out of gear by pushing the handle, T, of the lever, M, to the left, when the catch, U, falls down and holds the lever, so that the roller, P, stands free of the cam, B, and the action of the starter ceases. The pumping into the cylinder of a full charge of explosive mixture is only necessary when the cylinder is filled with a spent charge or with gas. When filled with air (as is always the case if the engine when stopping has made a few revolutions after the gas was turned off) it is sufficient to pump a few strokes of gas only, and follow on with explosive mixture. In this case the exhaust valve must be left closed.

Water-Power.—Messrs. P. C. Middleton & Co., Aberdeen, who recently completed the large water-power installation at Braemar for Mr. A. H. Farquharson, of Invercauld, have been entrusted with the electric lighting of Invercauld House. Water-power will be used, and 300 lights will be installed.

Werner Cadmium Accumulator Syndicate, Limited.—We are informed that a meeting of the directors of the Werner Cadmium Accumulator Syndicate, Limited, was held at 41, Devonshire Chambers, Bishopsgate Street Without, on Saturday, Mr. Alexis Werner, D.Sc., in the chair, when a satisfactory report was made as to the progress of the company. It was stated that important tests have been made and several orders have been booked for train lighting and traction. The chairman reported that progress was being made with the arrangement for floating a company in Paris, where the use of accumulators for traction is very extensive, and a letter from Belgium was read, with a proposal for the purchase of the patent rights for that country.

ELECTRIC LIGHTING NOTES.

Aberdeen.—At a recent Council meeting, Mr. Blackman's resignation from the post of electrical engineer was discussed. It was generally regretted that a greater effort had not been made to retain good engineers at higher salaries. Mr. Blackman is coming to London, and Aberdeen is to engage another engineer at the same salary as it paid him, £225. The Council passed a resolution thanking Mr. Blackman for his services.

Ambleside.—The electric lighting question has been before the District Council at a special meeting this week.

Barking.—The Council has received the sanction of the Local Government Board to borrow £15,000 for electric lighting.

Barnes.—The Board of Trade has issued a provisional order to the Urban District Council empowering them to supply electricity throughout the whole of the area within their jurisdiction, but excluding Hammersmith Bridge.

Bedford.—The Town Council, having applied for a loan of £5,400 for electric light extensions, Mr. H. H. Law will hold a Local Government Board inquiry on June 15th.

Belfast.—The Council has resolved to make a charge of 7d. per unit for the current supplied for lighting purposes for the first hour and a half, and 2d. per unit afterwards; 4d. per unit for current supplied for motor and heating purposes for the first hour and a half, and 1½d. per unit afterwards; and 5d. per unit for church lighting.

Belgium.—Five firms sent in tenders for the supply and erection of the plant for the electric lighting of the railway station at Ghent for the Belgian State Railway authorities, the lowest being that of Messrs. Dierman & Co., of Liege.

Bermondsey.—At Monday's Vestry meeting, Mr. Cox, chairman of the Electric Lighting Committee, brought up a report of the proceedings of a meeting of the Committee held that afternoon. He stated that the Vestry would be aware that the Board of Trade had granted a provisional order, and that the Bill to confirm the order had already been read a first time in the House of Commons. The speaker read a letter from Sir Courtenay Boyle, stating that it was not without hesitation that the Board decided to grant the order in view of the objections put forward by the London Electric Supply Corporation and the County of London and Brush Electric Lighting Company. The Board of Trade, the letter proceeded, had granted the provisional order with a view to giving Parliament an opportunity of expressing its opinion on the subject, and the Board intimated that should the order be opposed in Parliament, it would be necessary for the Vestry to take steps to support the Bill. Mr. Cox went on to say that the electric light companies had only laid mains in the parish for the purpose of supplying other districts, and that they were liable to penalties for not fulfilling their obligations. With regard to the confirmatory Bill, which was down for second reading this week, Mr. Cripps had given notice of motion that the Bill should be read "that day six months." Should the Bill pass its second reading, it would be referred to a committee, and it would then be necessary to secure the services of counsel in the event of opposition at that stage. The Electric Lighting Committee accordingly recommended, and the Vestry decided to give them permission to engage counsel to promote the interests of the Bill. With reference to the forthcoming telephone conference convened by the County Council, the General Purposes Committee reported having received a letter from the London County Council, stating that since sending out invitations for the conference, the report of the Joint Select Committee of both Houses of Parliament on the supply of electrical energy in bulk had been issued. The report raised some important questions affecting London, especially as regards the erection and subsequent purchase by local authorities of generating stations for the supply of electrical energy. The letter further stated that it had been decided to bring these matters forward for discussion at the conference to be held on June 14th, after the matters relative to the telephone service had been disposed of.

Bethnal Green.—The Board of Guardians Finance Committee has had under consideration a demand from the contractor, whose tender for the laying of an electric lighting plant at the new infirmary had been accepted, for an additional sum of money in order to carry out the work, so that the amount of that tender now reached £5,394. The committee offered Messrs. Calvert & Co. the sum of £5,000 to do the work, but they refused. It was decided to again advertise for tenders.

In anticipation of the Vestry carrying out the electric lighting of the parish, an electricity committee has been appointed to have all matters in regard thereto under its control. The committee is as follows:—Messrs. Hales, Mundy, Brooks, Kippins, E. Jones, W. H. Clark, Goodwin, White, H. Jones, Pitt, and Styles.

Bexhill.—The Local Government Board have sanctioned the proposal of the Council to borrow £20,000 for electric lighting purposes.

Birmingham.—In regard to the question of municipal purchase of the electricity undertaking, it is announced that at the City Council meeting on 14th inst. the report of the General Purposes Committee will be presented. The report is stated to show the great increase in the business and profits of the company since 1895, and recommends that the undertaking should be purchased if it can be obtained upon fair and reasonable terms. The Committee admit the necessity of taking market price as the basis for fixing the purchase money, and they offered, subject to certain conditions, to give the company £10 10s. per share (or £420,000), taking over the undertaking as a going concern, with all its assets and liabilities, as from January 1st last. The directors have expressed their willingness to recommend the acceptance of this offer to their shareholders. The Committee have received a report from engineers whom they instructed to examine the company's works and mains, showing that the whole of the buildings, plant, and machinery have been well designed, and so arranged as to be capable of easy, and therefore economical, extension as the business increases, and that they are in good condition, and in every respect suitable for the work they have to do. It will be necessary for the Corporation to obtain Parliamentary sanction for the purchase and the borrowing of the necessary capital. The total sum required to be borrowed will have to be repaid within such period as may be fixed by the Act. Upon a 42 years' period the annual charge to the Corporation for interest and sinking fund will be £16,275, on a 2½ per cent. basis, or £17,000 on a 2¾ per cent. basis, against which the Corporation will have an undertaking which for 1897 produced a gross profit of nearly £13,000, which it is safe to assume from the growth of supply in the last few years, will in a short time be not only sufficient to meet loan charges but to give an increasing margin on revenue account. The Committee therefore recommend the Council to purchase the undertaking on the terms now reported, and to authorise the Committee to take all necessary steps for promoting a Bill in Parliament during the next ensuing session for giving effect thereto.

Bognor.—The Urban Council have decided to appoint a committee to consider a public and private electric lighting scheme.

Brighton.—The Council last week adopted the report of the Lighting Committee, showing for what purposes it is proposed to borrow a further sum of £56,300 for the development of the electric light undertaking. In view of the congestion in the engineering and manufacturing trades, the Committee had been advised to apply for borrowing powers for at least two years' requirements, so as to avoid, as much as possible, a recurrence of the serious state of overload the works were in at the commencement of last winter, owing to growth of the business having been exceptionally rapid. The estimate for the two years' requirements is as follows:—

Four steam dynamos	£21,980
Additional 10-ton traveller	300
Two new feeders	6,300
Additional distributing mains	12,600
House services and meters	15,120
	£56,300

The total expenditure and liabilities up to the end of 1897 stands at £229,375. Application will be made to the Local Government Board for power to borrow the money.

Buckley.—The Lighting Sub-committee have under consideration an electric lighting scheme, and will shortly lay a report before the Council.

Bury.—At the Town Council meeting on Thursday week, the salary of the electrical engineer (Mr. Watson) was advanced from £200 to £250 per annum. The chairman of the Electric Lighting Committee (Mr. Pickup) explained why they had recommended the increase, and submitted a number of statistics showing that, although in its electric lighting scheme Bury was very similar to Oldham, Bolton, Dewsbury, Burnley, and Lancaster, they did not pay as much in salaries as those boroughs. He said that Bury paid £76 per annum more than the five towns named for sinking fund and interest, and the loss was only £46 more. Their income at Bury was £1,318 on the year, as against an average of £1,730 in the other places. The average salary paid to the electrical engineer in the five boroughs was £275 per annum, and in Bury only £200 had been given. Mr. Pickup also submitted figures to show that Bury produced electricity cheaper than the average of the five towns named, and on all these points being considered, the advance of £50 to their engineer was, in his opinion, well deserved. The vote for the increase was unanimous.

Cardiff.—Mr. Applebee, the electrical engineer, has reported to the Lighting Committee on the lighting of a portion of Newport Road by electricity. It would require, he says, 15 arc lamps of the same power as those in use for the centre of the town. The standards should be fitted with brackets for glow lamps to be lighted after midnight. Capital outlay £470. If this system were adopted, the lamps would be lighted directly from the current in the service mains by men employed for the purpose. This would greatly reduce the capital cost, because rectifiers, which now have to be supplied in the centre of the town, would be avoided. The committee adopted the report.

Colchester.—Representatives of the Electric Light Works Committee have had interviews with Mr. Massey and Messrs. Siemens, respecting the supply of fittings and wiring of consumers' premises, and reported the views of Mr. Massey and Messrs. Siemens on the subject. The Committee has resolved that further consideration be adjourned.

Colwyn Bay.—A Local Government Board inquiry was held on 2nd inst. in regard to the District Council's application for sanction to borrow £2,000 for the electric lighting of the promenade. Mr. Clirehugh gave evidence as to the details of the scheme, stating that the plant would not be in duplicate for reasons stated in the scheme. There will be 24 arc lamps placed on 21-feet columns along the promenade. The scheme was opposed by Councillor Wm. Davies, who was in favour of an installation which had been proposed for supplying the whole town rather than confining it to the promenade.

Crewe.—On 1st inst. the Town Council considered communications from Dr. John Hopkinson regarding his fees for reporting upon electric lighting and supervising the carrying out of a scheme. In one of his letters Dr. Hopkinson said that if his partner, Mr. C. Hopkinson, took charge of the refuse destructor matter, his fee would be 50 guineas. The Council accepted Dr. Hopkinson's terms of 100 guineas for a report on an electric lighting scheme for the borough, including one visit to Crewe, and a detailed estimate of capital outlay.

Devonport.—After visiting the town, Prof. Kennedy advises that the site adjoining the Corporation property at Pottery Quay is suitable for the electricity station.

Dover.—The Dover Electricity Supply Company intends on July 1st to reduce the charges for current.

East Grinstead.—Several would-be promoters of electric lighting schemes have been informed by the General Purposes Committee that any discussion discussing the matter are at present premature. It will be remembered that the Council is considering the question.

Glasgow.—Mr. W. A. Chamen, the borough electrical engineer, has reported on the lighting of St. Andrew's Halls. He says that arc lighting for a hall of this kind will never be made pleasing to the public. After going into the matter, he finds that two rows of seven electroliers, containing 17 16-C.P. lamps each, will be sufficient to light the main body of the hall, whilst the orchestra can be lighted by two more similar electroliers, supplemented by some brackets at the back. The present incandescent lighting of the back gallery will need to be increased by the addition of eight more 16-candle-power lamps fixed in the ceiling. The amount of electric energy consumed by the incandescent lighting now recommended will be double what is at present used for arc lighting. For the Berkeley and Kent Halls similar electroliers, with about 10 lights each, will be required. The cost of making the alterations would not be great, as the arc lamps would probably be transferred for use in other buildings belonging to the Corporation which are about to be lighted, or made use of in some other way. New electroliers would have to be purchased, together with a few brackets. The whole cost, including slight alterations to the wiring, and substitution of short pendant fittings under the galleries in the large hall, in place of the ship's fittings at present in use, would not exceed £300. The committee recommends that Mr. Chamen be authorised to proceed with the work, but meanwhile only in the large hall.

Guildford.—The Council has accepted the offer of Mr. J. M. V. Money Kent, on behalf of the Guildford Electricity Supply Company, to pay the sum of £30 in satisfaction of the claim made by the Council for damage to the paving.

Hackney.—The new Vestry had a long discussion on 1st inst. on the electric lighting question. Some members are clearly pledged to do their level best to prevent the scheme being carried out. The Electric Lighting Committee is made up as follows:—T. Barnett, W. L. Beurle, E. Errington, W. Hammer, F. W. Hart, G. Hasemer, W. H. Netting, G. A. Ogan, J. W. Sandwell, J. Sheehan, A. Walmsley, and L. Whitemore. There is now every reason for believing that the Vestry will soon get to work upon an installation.

Hastings.—The Local Government Board have asked the Hastings Town Council to obtain the report of a competent engineer upon the question of the Council's application to borrow £58,000 for the purchase of the Electric Light Company's undertaking.

Islington.—Our readers have heard Mr. Lambert's name mentioned over and over again in connection with the electric lighting undertaking; in fact, the success of the works might safely be called the success of Mr. Lambert. We therefore notice with regret that the progressive majority on the Vestry proposes to oust him from the chairmanship of the Electric Lighting Committee. The difficulty is to see any good reason for this move. The local press is expressing itself in strong terms on the matter.

Lancaster.—The Corporation Gas Department is feeling the opposition of electricity. Last year the amount sold to private consumers was £249 3s. 1d. less than the previous year, or £1,799 6s. 7d. less than the year ending March, 1895, which was the high water mark in the sale of gas. The increase in the amount for electricity last year was £699 12s. 2d. In the last three years the increase has amounted to £1,146 16s. 4d. The Lighting Committee's altered expenditure has affected the Gas Department, for whereas in 1894-5 the outlay on gas lighting was £1,934, and on electricity £133, these items cost in 1897-8, gas £1,726, and electricity £505. In the other Corporation departments there are increases in the consumption of both gas and electricity.

Leeds.—The Leeds Corporation and House-to-House Electricity Provisional Powers have been granted to the Leeds Corporation for the purchase of the electrical system and plant of the Yorkshire House-to-House Electricity Company.

Lewes.—The Town Council has resolved that the question of opening up negotiations with a company with a view to taking up the provisional order for electric lighting be referred to the Finance and General Purposes Committee, with authority to negotiate terms for an agreement to be entered into, and to be hereafter submitted to the Council.

Lombardy.—As the use of electricity, both for lighting purposes and as a motive power, in Lombardy is constantly extending, says the *Financial Times*, there is consequently an ever-increasing demand for all kinds of electrical appliances connected with its development. At present Switzerland and Germany would appear to have the lion's share of the business in supplying the machinery, and our Consul points out that British engineering firms do not seem to be making any effort to secure a share of it. In 1899 the centenary of Volta's discovery of the electric pile is to be celebrated in Como, his native town, by an International exhibition of electrical appliances, and in due time our Consul promises to send full particulars of the conditions on which firms are to be invited to exhibit. In the meantime British manufacturers of electrical machinery might find it to their interest to give the matter their attention.

Londonderry.—The Corporation last week held a special meeting to consider the offer of the New General Traction Company, Limited, to take over the entire electrical plant of the city, to light the streets as at present, and to supply private light and power to all applicants. Dr. Todd, solicitor, said that the company were prepared to take over the plant at a valuation. They bound themselves to give light to the public lamps at £15 10s. per lamp, to give private lighting at 4d. per unit, and power at 2½d. per unit. The company owned 11 miles of tramways in Coventry, 20 miles in Norwich, and four miles in the Isle of Man. It had an invested capital of half a million. Councillor Thompson asked what guarantee there was that the company would carry out what they offered. Dr. Todd said the best guarantee was, that they would spend about £100,000 in laying down plant. They had in view the working of the Strand tramway by electricity. He estimated that there would be a saving of £1,360 on the public lighting. In that, of course, he included £1,000 for

depreciation at the rate of 5 per cent. Alderman O'Doherty said the danger was, that when they came to make up the valuation they might be told that their plant was antiquated, and not worth much. The better way would be for the company to mention a lump sum of the basis of the negotiations. Eventually the Corporation appointed a small committee to confer with Dr. Todd and report.

Ludlow.—The Town Council will hold a special meeting on July 7th to consider whether an electric lighting order shall be applied for.

Northampton.—The Town Council, which is desirous of erecting refuse destructors in the town at once, has temporarily postponed all questions of details until the result is known of the negotiations with the Northampton Electric Light and Power Company for the purchase of the company by the town, and with the Northampton Tramways Company for the purchase of their system by the municipality. In the event of both purchases being made, the town will combine refuse destruction with the generation of electricity, which, amongst other things, will be employed for tramcar traction.

Oldham.—At a meeting of the Electric Lighting Committee on Wednesday, Mr. Newington, electrical engineer, presented a return of the electricity works. The works were commenced in 1894, and the total cost for fourth year (1897-8) has been £2,345, against 1896-7 of £2,533. The number of units sold during the year was 322,203, against 227,982 in the previous year. The average price obtained was from private consumers 4·28d., and from public 3d., against 5 7d. and 4d. last year. The gross profit made before setting aside instalments for interest and sinking funds, was £3,492 against £2,946. The total cost per unit was 1·746d., the decrease being 0 921d. The producing of supply at such a low price is considered very satisfactory. Mr. Newington said that the output was nearly as much as the plant could meet, although extensions had been made recently.

Pembroke.—Last Saturday a Local Government Board inquiry was held with reference to the Town Commissioners' application for a £33,000 loan for electric lighting. Mr. Robert Hammond gave evidence regarding the scheme. He stated that the tenders received, including boiler house, engine house, switchboard, accumulators, all the underground work and the meters, amounted ot £19,354, against the engineer's estimate of £19,850. The cost of the condensing plant was estimated at £1,500. They proposed to use a triple concentric cable, which would be thoroughly insulated, lead covered, and steel armoured, and not at high tension. They were laying down two dynamos of very first-class make, which could do 5,000 lights, which would be capable of supplying 12,000 lights on consumers' premises. The distribution was to be on the three-wire system, the total length of the cables being 14,100 yards. The cost of the buildings is put at £6,000, with the exception of the destructor works.

Penarth.—The Board of Trade has issued a provisional order to the Penarth Electric Lighting Company, Limited.

Peterborough.—The Town Council had a discussion last week regarding the salary to be paid to the newly-appointed electrical engineer, Mr. Gill. The Lighting Committee had resolved to pay £100 a year, but last week the Council reversed this decision by nine votes to eight, and made the salary £50.

Reading.—A deputation recently waited upon the Board of Trade upon the matter of the amended description of the systems of supply to be adopted by the Reading Electric Supply Company. The Board wrote to the company, stating that they are not satisfied that the reasons urged on behalf of the Corporation are such as would justify them in withholding their consent to the proposed change of system, and they propose to approve the amended description. The Reading Electric Light Company recently wrote to the Council asking them to adopt electricity for street lighting, but the Lighting Committee has recommended the Council that the company be informed that if the Council determine to light the public streets by electricity, they will probably provide works for the supply of energy for that and other purposes. The Reading Electric Supply Company intend to alter the standard pressure of their supply at consumers' terminals from 100 to 200 volts.

Rhodesia.—We understand that the electric light is being installed at the B.S.A. Police Camp, Government House, which is four miles from Buluwayo.

Shoreditch.—At the first Vestry meeting after the election, held on Tuesday night, Mr. S. G. Porter was unanimously selected as chairman for the ensuing year. The Lighting Committee recommended and the Vestry decided to insure the economiser at the electricity works with Messrs. Green & Sons, Limited, of Manchester, for the sum of £500, at an annual premium of £3 10s., the rate to include periodical inspection of the economiser. The same Committee announced that it had been agreed that Mr. Russell, the chief electrical engineer, should supervise the arrangements for supplying steam to the baths and washhouses.

Tipton.—The Midland Electric Corporation has intimated to the District Council that it will accept a maximum of 3d. instead of 3½d. per unit. These terms the Council considered satisfactory.

Walthamstow.—A Local Government Board inquiry was held recently into an application by the District Council for sanction to borrow £5,200 for about two acres of land as a site for an electric lighting station and a stone yard. Mr. Enright, the electrical engineer, spoke strongly in favour of the site, and said the saving on the cartage of coals would alone pay the interest on the money. The whole district could be lighted from this station at the lowest possible cost.

Watford.—A Local Government Board inquiry was held on 31st ult. in regard to the Council's proposal to borrow £21,000 for electric lighting. Mr. Hawtayne, consulting electrical engineer, explained the scheme. He calculated an immediate demand for 8,000 lights. 130,000 Board of Trade units would be required for lighting the streets, and the present lamp standards could be utilised. He had some idea of putting arc lamps in the High Street and part of Queen's Road. For private lighting there would be 4,000 lights of 8 C.P.; public lighting, 363 of 16 C.P.; and 100 of 32 C.P., making 5,126 lamps of 8 C.P. He had considered several sites, and had come to the conclusion that the best was the one adjoining the sewage works. The estimated cost of the building was £3,000, and it would be handy for coal delivery. There was no opposition.

Wednesbury.—At Monday's Council meeting the General Purposes Committee recommended the Council to withdraw its opposition to the application of the Midland Electric Corporation upon the terms that the Corporation supply electricity to the Council for lighting and power purposes within an area agreed upon the same terms and conditions (if any) as may hereafter be agreed upon with the local authorities of West Bromwich, Oldbury, and Smethwick; that the Corporation will not oppose the application of the Town Council for an electric lighting order at any future date. On Monday, when the matter was discussed, Alderman Williams said he believed the whole thing was intended to put a stop to the action of the Midland Electric Corporation. They ought rather to be glad that people were prepared to bring electricity to them for the benefit of the town. Alderman Lloyd also argued that encouragement should be given to schemes for the development of new industries in the borough. The above proposals were adopted.

Whitechapel.—It is stated that the District Board of Works is asking the Brighton Corporation electrical engineer (Mr. Wright) to advise upon the electric lighting of the district.

Wigan.—At the Council meeting on 1st inst., Mr. Alderman Holmes, in moving the confirmation of the minutes of the Gas and Electric Lighting Committee, said that the question of electric lighting, which was brought forward at the last meeting and deferred, was again deferred by the Committee until after an expression of opinion had been given by the Council. The Committee felt that that was one of those matters that must be connected with a loss to the town for some years to come, if adopted. They therefore wished to have the full sanction of the Council behind them before proceeding any further. Mr. Worthington said, with regard to the electric lighting, although that matter had gone back to the Gas Committee, it had come back again to them in the same form. Since then he had acquainted himself more with the subject, and he would be prepared now to endorse the resolution that was previously sent back, with regard to the appointment of a sub-committee. He found that so far back as 1890 there was an electric lighting order which had received the Royal assent in favour of Wigan, and which only applied for two years, or during such a period as the Local Government Board might consent to extend it, and he believed that it was open to a company or syndicate to apply to the Local Government Board for the transference of the power of the order to them in order that they might supply electric light to the town. It seemed that they were in a rather difficult position. They had a gas works with a capital of £350,000 on the one hand, and they were loth to interfere in any way that would reduce the assistance that the rate got from that very important undertaking. On the other hand, it might be that some company might be disposed to supply the town with electric light. And let them suppose that after a loss for a little time that company eventually turned to a profit, then they would have the same competition from an outside company that they were supposed to have from themselves if they adopted electric light. If the outside company went on making a profit, and if the Corporation wanted to turn the electric light to themselves, they would be in the same dilemma as when they bought the gasworks, and would have to purchase them at far more than the original cost. Electric lighting had made important strides since the last committee met, and he believed in the appointment of a small committee of the Council, apart from the Gas Committee. After discussion, the Council appointed a sub-committee to make inquiries, and with the powers to employ experts to advise them, so that they would be able to recommend to the Council something definite upon which they could act, and which would prevent the electric lighting going into other hands.

Winchester.—Last week the City Council had before it tenders from the Winchester Electric Lighting Company and the Water and Gas Company for lighting the streets. The Gas Company's tender was accepted.

York.—The Local Government Board has sanctioned the borrowing of £20,000 for electric lighting purposes. At Monday's Council meeting it was stated that Prof. Kennedy reported that Messrs. Crompton & Co. now found that they could not recommend the lowest priced engines accepted by the Corporation. The Electric Light Committee, therefore, had decided to instruct Messrs. Crompton to obtain the better class engines mentioned in the tender, and the cost of the plant would therefore be increased from £8,176 to £8,654. It was stated that the Committee would now push the matter forward as fast as they could, and they hoped that some time within the next 12 months they might be able to see the electric light established in the city.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Barnsley.—The Streets, Buildings, and Improvement Committee of the Town Council have been considering the question of tramways for the town, and have now expressed the opinion that it is desirable such tramways should be established and worked by a company and not by the Corporation. Their recommendation that the Council invite companies to submit schemes of tramways for the town, and give consent to an application for the necessary Parliamentary powers to construct tramways in the borough, was before the Council on Tuesday. The Lighting Committee recommend that instructions be given to Mr. Miller to prepare plans and details of the proposed electric lighting scheme (see Electrical Review, May 20th), and that application to borrow £23,322 to pay for such works be made.

Belfast.—The Tramway Company has written to a Corporation Committee saying that the directors have again been going into the matter of electric traction, and as there was a rapidly growing feeling among the public, they are willing to make another effort to come to terms with the Corporation for its introduction in Belfast. The Corporation has accordingly appointed a small committee to meet the directors to go into the matter.

Birmingham.—The Lord Mayor has sent to the *Birmingham Daily Post* copies of the letters which have recently passed between the City of Birmingham Tramways Company and the Corporation in regard to the proposed introduction of the overhead wire on a section of the lines.

The City Council had a lengthy discussion on the tramway question on Tuesday, the end of which was that it was decided by 28 votes to 27 (six neutrals) not to re-open negotiations with the Tramway Company, as the company has failed to carry out their arrangement with the Public Works Committee, and Mr. Ross, the chairman of the company, has made statements, which were incorrect, *re* authority to use the overhead trolley.

Brighton.—In the House of Commons on Monday, Mr. Ritchie informed Mr. Bowles that the electric railway from the Aquarium to Preston Place Groyne, Brighton, was constructed on land belonging to the Corporation, without Act of Parliament. As it was above high-water mark, the sanction of the Board of Trade was not necessary, and he had no jurisdiction over the railway. With regard to the Brighton and Rottingdean Sea Shore Electric Tramroad, the provisions of the private Act were not binding on the company, unless otherwise agreed between the company and the Corporation, who were the owners of the foreshore on which the line was constructed. The consent of the Board of Trade was given to the construction of the works below high-water mark, including the poles for the overhead wires. He was not aware that the public and boatmen were exposed to any danger, but as to the possibility of depriving them of their right to use the foreshore, he would make inquiries, though he did not think the Board of Trade had any power in the matter.

Bristol.—The following figures show the popularity of the electric tramway service on Whit Monday:—Last year on Whit Monday 104 cars were run and 127,387 passengers carried. This year 121 cars were run and 130,851 passengers carried, being an increase of 3,464 passengers. Of the above number this year no fewer than 50,817 were carried on the Staple Hill and Kingswood electric lines.

Chatham and Gillingham.—During last week both the Chatham Corporation and the Gillingham Urban District Council had under discussion a scheme for the introduction of an electric tramway in certain parts of the district. A special feature is the provision of workmen's cars. The Light Railways Commissioners, at their recent inquiry, cut out what is known as the High Street route, considering that the street was too narrow to admit of the proper working of trams, but there is very little doubt now that the trams will be introduced in this district, and will run from the Dockyard to Gillingham and Luton. The great question now under discussion is the conditions to be carried out by the company as to providing workmen's carriages. The promoters of the scheme have put forward their views as to providing workmen's cars, and the company will agree to contribute £6,000 towards the cost of widening the street, and £1,500 towards the erection of a new bridge across Railway Street. Some of the Council are in favour of the Corporation having the trams in their own hands, while others wish the company to take the matter up at once, considering they would be a benefit to the towns and the trade generally.

The Light Railways Commissioners concluded their inquiry on on Monday at the Sun Hotel, Chatham, for determining the expediency of granting the application made to them by the Rochester, Chatham, Gillingham and District Electric Railways Company, Limited, for an order to authorise the construction of an electric railway through the district. The Commissioners have decided to recommend that the order be made, and tramlines will be laid to and from the dockyard gates to the Brook and Military Road, and from thence along the Brook to Luton, and also from the upper and lower dockyard gates to Old Brompton and New Brompton, and also Gillingham. This will be a great boon to the district.

Dover.—Our local correspondent informs us that so successful have been the Dover Municipal electric trolley trams during the six months they have been running, that the Corporation were, as a consequence, able to reduce the town rates by 2d. in the £. There are four miles of tramways, and the fare 1d. any distance. More new cars are on order, and as soon as these arrive, a five minutes regular service is to be established.

The electric trams did well on Whit Monday. £56 18s. being taken. This is over £1 more than on Easter Monday, and it is stated to be £39 18s. more than is necessary to cover the day's capital and working expenses.

Dudley and Stourbridge.—On 3rd inst., Sir Francis Marindin, inspector to the Board of Trade, made an inspection of the Dudley and Stourbridge tram line, in consequence of the formal application of the owners for a seven years' steam power license, the existing license terminating in the near future. Mr. S. Sellon (engineer to the British Electric Traction Company) was one of the party. During the inspection of the whole of the line it was stated that the application was merely a formal one, but that it was necessary; also that electric cars would be running in the coming autumn.

Dundee-Barnhill.—The Dundee Town Council has remitted this light electric railway scheme to the Works Committee, who will appoint a sub-committee to report upon the proposal.

Gateshead.—So that the Council may have a good idea what the electric trolley tramway system really is, the whole body is to go to Leeds to inspect the system there.

Glasgow.—A proposal is before the Corporation to raise the salary of the tramway manager from £1,250 to £1,500. This is in view of the change from horse to electric haulage. There is also a proposition that in view of the surplus in the tramway receipts, and of the introduction of electrical traction on the Springburn route, it be an instruction to the Tramway Committee to reduce the fares on that route as an experiment.

The Tramways Committee proposes various tramway extensions amounting altogether to 11·13 miles. The sub-committee have had under consideration communications from the British Electric Traction Company, who had given notice of plans, sections, &c., embodying full particulars of the proposed light railway extensions to the Paisley and Johnstone tramway system, and suggesting that a meeting might be arranged. Sir James Marwick wrote that the Corporation would oppose the proposals of the company to construct a light railway on a road on which the Corporation had been authorised by Parliament to construct an extension of their tramway system. They would also oppose the company obtaining powers which would prevent such extension. The sub-committee had also a meeting with a sub-committee of the District Committee of the First or Upper District of Renfrewshire with reference to the application of the British Electric Traction Company. The Corporation Sub-Committee stated that they were prepared to recommend the Corporation to resist the application so far as relating to roads in or leading into the city, and to apply for powers to extend the Corporation tramways along Paisley Road from Halfway House to Paisley. They also stated that the Corporation, in the event of powers being obtained to construct a double line of tramways, would pave and maintain the roadway within the tramway rails and for 18 inches on the outside thereof, as in the case of other tramways. The County Sub-Committee of the Upper District stated that they were favourable to an arrangement being come to with the Corporation, provided the Corporation would undertake to lay the tramways in question within a limited period, and that they would report the result of the meeting to their committee. On the report by the general manager, the sub-committee have agreed to accept the offer of the Westinghouse Company to equip the High Street line for electric traction on practically the same terms as their contract for the Springburn line. It was also agreed that the convener should act as representing this committee on the sub-committee in charge of the lighting on the Springburn route.

Halifax.—The official opening of the municipal electric tramway was to take place yesterday (Thursday).

Harrogate and Knaresborough.—The promoters of the Harrogate and Knaresborough Light Railway have prepared the necessary plans, &c., and these are being deposited with the various public bodies interested in or affected by the scheme. The promoters have been encouraged by support from all the local authorities, with the exception of Harrogate. According to the plans the length of the direct line from Station Parade, Harrogate, to the terminus at Knaresborough is 3 miles 4 furlongs and 6 chains. Provision is also made for a loop line and sidings, so that altogether rails will be laid for distances of 4 miles 5 furlongs and 5 chains. The estimated cost is £76,000. What may be termed the main line starts near the Jubilee Monument in Harrogate, thence proceeds by Station Bridge and North Park Road to the Knaresborough Road, which it follows through Starbeck, and on to Knaresborough, terminating in Fisher Street. The loop line intended to serve High Harrogate leaves Station Parade in an opposite direction, but ultimately forms a junction with the main line in the Knaresborough Road. Electricity will be the motive power. It is proposed to have the generating station at Starbeck, to which access will be obtained by means of a short siding. The promotors also intend applying for powers to lay down a main to the generating station in order to utilise water at present running to waste.

Hull.—The arrangements for the commencement of the construction of the electric tramways and the repaving of the main streets with wood are about complete. A start at taking up the old rails has been made on the Hessle Road, and it was arranged that the first rail of the new sytem should be laid yesterday afternoon by the chairman of the Works Committee at the south end of Porter Street.

Leeds.—The City Council at a recent meeting decided to extend the electric tramways to the Headingley, Chapeltown, Hunslet and Dewsbury Road sections, and Dr. Hopkinson, under whose charge the Kirkstall and Roundhay sections were laid, was engaged to carry out the work. The Tramways Committee had a consultation with Dr. Hopkinson on Monday, and an electrical sub-committee was appointed to confer with that gentleman with regard to the enlargement of the generating station, the necessary engines, and other details. Estimates will shortly be obtained, and the work will then be proceeded with without delay. A model of an apparatus was exhibited to members of the committee, the object of which is to prevent accident to life or limb in the event of an overhead wire breaking, by automatically shutting off the current. The apparatus, for which a provisional patent was obtained last month by Mr. Ralph Bostock, licensed victualler, and Mr. Frank Arthur Cheetham, silk spinner, Brighouse, is attached to the poles, and it is claimed for it that as soon as a wire breaks, the current between the poles is shut off. Mr. Hannam (the chairman) and other members of the committee thought favourably of the invention, but suggested to the patentees that it should be tested with trolley wires of the same thickness as those in use in Leeds, a suggestion which they decided to adopt.

In consequence of the breaking of a guard wire last week, it is stated that thicker guard wires are to be used throughout the entire route.

Limerick.—The Electric Tramway Company, Limited, have notified their intention of applying for permission through the city and county grand juries for permission to lay down a series of tramways through the city and suburbs, the gauge varying from 3 feet 6 inches to 5 feet 3 inches. Though the scheme has been outlined, the plans have not yet been furnished.

Liverpool.—At last week's City Council meeting, Mr. C. Petrie submitted the recommendation of the Generating Stations Committee—"That the tender of Messrs. Willans and Robinson, Limited, Rugby, for the supply of two compound engines and dynamos at the price of £6,530 each, and one triple-expansion engine and dynamo at the price of £6,939, subject to a deduction of 2½ per cent. upon the respective amounts, be accepted." The engines, Mr. Petrie said, were for the generating station in Pumpfields, for lighting and traction. The question was purely technical, and the Council would be well advised in taking the opinion of its officials, who recommended the proposed engines. Some little misapprehension existed to the effect that there was a difference of opinion between the reports of Dr. Hopkinson and Mr. Holmes, their electrical engineer. He had mentioned this to Dr. Hopkinson, who had written stating:—"I am of opinion, and always have been of opinion, that the engines proposed by Mr. Holmes for the new large central station will give thoroughly satisfactory results both for traction and lighting." The committee's recommendation was referred back to the committee last month. The committee had since further considered it, and they felt, having the report of Mr. Holmes before them, that they could not alter their recommendation. It was only because the Council did not quite understand the matter that the recommendation was referred back. Many misleading statements were made last Council meeting. One was that the engines made 800 revolutions, whereas they made only 230. The committee had inquired fully into the question, and if they were not perfectly confident that this machinery would give the greatest possible satisfaction, they would not have recommended its purchase.—Alderman F. Smith seconded the recommendation.—Mr. Rutherford moved as an amendment: "That before ordering the high speed engines mentioned in the recommendation, the special committee be requested to obtain the unbiassed opinion of Sir Benjamin Baker, Sir Frederick Bramwell, Mr. Kincaid (of London), Mr. Pearson (of New York), or some other acknowledged authority of eminence and experience in electric traction upon the two questions (*a*) the unit of power; (*b*) the type of engines it would be best for Liverpool to adopt in the projected 10,000 horse-power power station at Pumpfields." He did not assert that the engines recommended were not the right kind to order, but he thought the Corporation should take the best authority on the subject before committing the city to a large expenditure. The recommendation was the same as that submitted at the last Council meeting, when it was sent back to the committee on its merits. Now, however, personal matters had been introduced into the consideration of the subject, and some members who voted against the recommendation last month had that day told him that they would now vote against him whatever he might say. Mr. Petrie had referred to Dr. Hopkinson's letter, and suggested that that letter got rid of the difficulty of the difference of opinion between Mr. Holmes and Dr. Hopkinson, but that opinion was not official. He had no personal hostility towards the committee, and he trusted that if his amendment should happen to be carried Mr. Petrie would not resign. On the other hand, he might assure them that were he (the speaker) beaten he would not resign. Mr. Rutherford proceeded at great length to give a history of the business from June 11th last year, when Mr. Holmes was asked to report on the electrical power for the trial route to the Dingle. He pointed out that Mr. Holmes considered that economy and efficiency would result from combining the generation of electricity for lighting and tramway traction. Mr. F. S. Pearson, who had had twice the experience of anybody else in electric tramcars, thought differently, and said so. That was why, when Mr. Pearson was proposed as consulting engineer, the electric light section of the Council, having determined to get control of the electricity for the trams, rose as one man against Mr. Pearson's appointment, and swore they would have none of him. Mr. Holmes now recommended for the new electric generating station at Pumpfields high speed machinery whose type was experimental, made by makers to whom the construction of the engines was an experiment, and modified besides by novelties in design which Mr. Holmes had introduced. He contended that Dr. Hopkinson had not endorsed, but excused, these recommendations, and in the course of an extended argument urged that slow speed engines were the best for developing large power like 2,500 or 3,000 electric horse-power, which ought to be the unit. They were entitled to know not whether these recommended engines would give satisfactory results, but whether they were the best type, and what was the best unit of power to adopt, because they were making a start with a huge undertaking which would not only provide light for the streets and traction for the tramways, but be eventually the source from which all the small industries of Liverpool would draw their power. Mr. Rutherford proceeded to urge that the proposed engines were unsuitable for traction purposes, because they were high speed, and, therefore, more difficult in governing any variability of load, and more liable to lead to accident on account of the high rate of speed. He cited various authorities showing that the slow speed engines were more suitable for traction purposes. At all events, he submitted there was a reasonable doubt as to which form of engine was the better, and expert evidence should be obtained upon it. The experience of the whole world was that slow speed engines should be used; but at least the Council before deciding upon any definite policy should take the opinion of the leading engineer in England—someone above petty considerations, and whose knowledge would guide them to a proper and just conclusion.—Mr. M. Hyslop Maxwell seconded the resolution.—Alderman Fred. Smith defended the action of the committee. Mr. Rutherford asked them to take the opinion of some expert. Had they not appointed Dr. Hopkinson as an expert? Referring to the unofficial letter sent by Dr. Hopkinson, the speaker contended that that gentleman would not go back upon the opinion therein expressed even in an unofficial letter. The alderman was proceeding to criticise Mr. Rutherford's speech, when the Council adjourned.

When the Council met again on the 3rd inst. the matter was continued in spite of Mr. Rutherford's proposal to withdraw his amendment. Mr. Petrie, as chairman of the committee, objected to that course because Mr. Rutherford had made certain statements which must be answered, and they had a complete answer to every one of them. Alderman F. Smith, who continued the debate, said that what he understood the Council desired to do was to undertake a very great and beneficent scheme of electric traction for Liverpool. In the preparation of that scheme the committee thought it desirable to provide two stations of 10,000 horse-power each. Mr. Rutherford had pictured the terrible effect that would happen to Liverpool in case all the tramcars were stopped at one moment. If Mr. Rutherford had been a little more candid with the Council he would have told them that he had asked this very question of the engineer, and that the engineer had explained to him that it would mean that Liverpool trams would run in four sections, so that no such disaster as that pictured by Mr. Rutherford could possibly take place. With regard to the type of engines that should be used undoubtedly there was no settled and absolute opinion even amongst the foremost electrical engineers. Alderman Smith then devoted himself to arguments justifying the committee's confidence in their electrical engineer. The only modification made by Mr. Holmes to adjust the engines to what he deemed to be the requirements of Liverpool was a change of fly-wheel. They wanted to put an engine down that would not wreck their station. The high-speed engine had a fly-wheel of not more than 16 tons, and had it within its dynamo. Whereas a slow speed had a fly-wheel, which was exposed, of about 60 tons. Accident was less likely with a high speed engine than a low speed engine. Electricity was a comparatively new science, and there was continual change and progress. Therefore, was it not reasonable that their able officials should be allowed to be in the van of progress, rather than following slavishly in the rear of other people? The committee followed Mr. Rutherford on another matter, and he led them into a little bit of disaster. The committee had to be led by somebody (Mr. Grant: Forwood), but were they going to be led by Mr. Rutherford, with the secondhand opinions of competitors for some of this Corporation work against the opinions of their capable officials. Mr. Rutherford was in this matter in a minority of one on the committee. With an expenditure of £20,000 the Council should trust the committee, if they were worthy to be trusted. As an individual member, he (Alderman Smith) had given the subject his best consideration, and had honestly come to the opinion that the advice of Mr. Holmes ought to be followed. Mr. Holmes was an electrical engineer of standing, worthy of being followed. He would follow Mr. Holmes until it was shown by competent authorities that he was wrong. The discussion was carried on at considerable length, and Mr. Petrie, the acting chairman of the Generating Committee, replied. He said that the committee never admitted that there was any difference between the report of Mr. Holmes and that of Dr. Hopkinson as to the type of engine to be purchased. Mr. Rutherford had discussed the question at the Council three or four times, and the points he raised had been answered intelligently and courteously by Mr. Holmes. Mr. Rutherford made statements which he had been told at the committee were wrong, and he had seen letters which intimated that he was wrong, yet he reasserted them at the Council. He had made the question a personal matter. He had said, "I will show you up in the Council. I will show your committee up in the Council and I will state a lot of things you won't like to hear." There was nothing any member of the committee had done that he was

ashamed of. If Mr. Rutherford knew of anything he should have stated it to the Council. He had two hours of the Council's time on Wednesday, which was practically wasted, and had only "shown himself up." The engines referred to at Bristol and Dublin were made for lighting purposes, but were tried for traction and found unsuitable, because they were never intended for traction. It had been stated that these engines were not used for traction in this country at all. That was quite incorrect, and Mr. Rutherford knew it was incorrect. They had worked, and with very satisfactory results at one of the stations of the South London Railway Company. They had worked for two and a quarter years, and the repairs to them had practically been *nil*. As to the variability of load the firm was willing to give any reasonable guarantee that the engines would stand any strain of that kind. The South London Railway Company were so satisfied with the engines that they had ordered 16 (?) sets of plant, each of 1,000 horse-power, for the railway. The municipalities of Leeds and Bradford had tried them and were ordering additional ones for traction purposes. The Liverpool Corporation had tried the engines for electric lighting, and had found them very satisfactory, as shown by the fact that they were the second cheapest producers of electricity in the cities of the United Kingdom. The cost of the engines would be about £20,000. On May 4th the Council referred the committee's recommendation back; but, after careful consideration, the committee had come before them again with the same recommendation. The committee had been guided by their officials, and it was to the interests of the officials that they should recommend what was best for the city. The division was then taken, the voting for Mr. Rutherford's amendment being 12, and against 49.

Manchester.—A sub-committee of the Swinton and Pendlebury District Council have arranged with the solicitors to the Manchester Carriage Company that the tram lines which are to be laid in Pendlebury shall be laid so that the cars may, if thought proper at some future time be run by mechanical power without necessitating re-construction when it is decided to adopt electricity.

Newcastle.—On 3rd inst. letters were before the special committee from Dr. Hopkinson and Mr. Colamb, stating their charges for advising *re* electric and cable traction. The committee has agreed to engage both gentlemen, and the city engineer is to supply them with plans showing the proposed routes. Both gentlemen are to draw their estimates from a given basis of mileage, weight of rails, strength of foundations, engines, and machinery of every description, and the quantity of rolling stock, both systems to be worked on a basis equal to a 2½ minutes' service. It was agreed to report meanwhile to the Council upon the routes which the committee considers should be included in the new scheme.

Norwich.—The recent action of the House of Commons Committee in cutting the Surrey Street route out of the electric tramway scheme has placed a serious obstacle in the way of the St. Stephen's Street and Newmarket Road line, and while it is not yet abandoned, no fresh steps have yet been taken to arrange for an alternative route. The Magdalen Road route also presents difficulties at present, owing to the operations in progress for sewerage, and this portion of the city cannot for some time be undertaken, although the line is likely to prove one of the most remunerative on the system. The contractors are therefore confined to three main routes, Thorpe Road, Dereham Road, and Aylsham Roads. All arrangements are now complete for the car sheds near the Prince of Denmark at Sprowston, and the building of these premises has begun.

Penarth-Cardiff.—On 1st inst. a public inquiry was held at Penarth by the Light Railway Commissioners (Earl of Jersey, Mr. G. A. R. FitzGerald, Colonel Boughey, and Viscount Emlyn, acting secretary), with regard to the proposed light electric railway from Penarth to Cardiff. Various local authorities, the Taff Vale Railway Company, and the Gas Light and Coke Company, were represented. Mr. Hans Hamilton appeared for the promoters. In opening the case he said the company was formed at the end of last year by some influential gentlemen in Cardiff and Penarth, and in conjunction with gentlemen who had been and who were connected very largely with electrical traction and electrical undertakings in London. So strong was the feeling in both towns of the necessity for the undertaking that, if necessary, all the capital could be found in Cardiff and Penarth alone. The nominal capital was £25,000, but power had been given to increase this if required. Penarth had an estimated population of between 17,000 and 18,000, and the population of Cardiff was 180,000. The distance from the Town Hall in Cardiff to the Post Office at Penarth was about four miles, and the traffic between the two towns consisted of gentlemen who resided at Penarth, and who went into Cardiff for business, whilst near the spot at where the proposed railway would commence, viz., Grangetown, there was a large and increasing working class population. If the light railway was granted, trams would be run every 10 minutes. The road between the two towns was privately owned by Lord Bute and Lord Windsor, and a portion of it was within the borough and a portion in the Penarth Urban District. It had been felt for some time that a great expansion of Penarth would follow if adequate communication was granted between the two towns, and in 1897 a syndicate was formed, called the Penarth Tramways Syndicate, of some of the leading inhabitants of Penarth and some of the principal business men of Cardiff, with the object of constructing electrical tramways in Cardiff and along the road proposed for the new light railway. The application was proposed to be made under the Tramways Act, but, as the Cardiff Corporation threatened to oppose, the project was dropped. The reason for the opposition at the time was, in the first place, the fact that the Cardiff Corporation desired to extend their borough boundary so as to include Penarth, and if the borough was extended they wished to construct the tramway themselves and to exercise their power of purchasing the existing tramways. As a result of the Local Government Board inquiry, however, the extension was not allowed, and that was why the present application was being made. The proposed light railway would commence where the houses ceased at Grangetown, and would end at the Post Office at Penarth, the total length being a little short of 3 miles. The Plymouth Road extension is dropped entirely. Lord Bute and Lord Windsor strongly advocated the construction of the light railway, and they would be willing, if the project was granted, to give land for the widening of the road wherever it was necessary. Counsel proceeded to deal at length with the objections of the Cardiff Corporation and the Taff Vale Railway Company.

Mr. Ll. B. Atkinson, electrical engineer at Cardiff, and residing at Penarth, said the gauge of the new line would be the standard gauge of 4 feet 8½ inches. The lines would be laid level with the surface of the road, and the road between the rails and for 18 inches on each side would be paved with granite setts or wood blocks at the option of the local authority. The railways proposed were four in number, No. 5 having been abandoned by arrangement with the District Council of Penarth. The four lines of rails would have a total length of 2 miles 5 furlongs and 6·60 chains, and would commence at Grangetown by a junction with the existing tramways. With regard to the inclines, Railways No. 1 and 2, from the commencement to the River Ely, would be on a practically level road, Railway No. 3, from the River Ely to Cogan Hill, would be on an incline of 1 in 19, and railway No. 4, which commenced on Cogan Hill, would have a maximum gradient of 1 in 13, for quite a short distance. It was proposed, however, to reduce this incline to 1 in 21. The width of the road was, for the most part, ample. The cost of widening the road had been included in the estimate. The mode of working the railway was by electricity with overhead wires, and the promoters were either prepared to erect their own generating stations or to enter into a contract with the Cardiff Corporation. A provisional agreement had been entered into by which the local authority could purchase the railway at any time after 10 years at a value excluding the goodwill, or, at any time after 35 years, they might purchase without a goodwill. He took it that the Cardiff Corporation would have the power of purchasing the portion in their district. It would be a single line, with loops for passing. He had known electric tramways to be erected on roads which had a greater incline than the Penarth Road. The speed would depend upon the local authorities, but he anticipated a speed of 9 or 9½ miles an hour, including stoppages.

Mr. Vivian Douglas Cooper, engineer, said that he estimated the total cost of the construction of the line would be, approximately, £19,043.

Mr. B. Francis Williams then proceeded with the opposition on behalf of the Cardiff Corporation. He called Mr. William Harpur, the borough engineer, who gave evidence against the scheme.

After hearing further evidence and holding a consultation among themselves, the Commissioners notified that they could not approve of the proposed arrangement between the promoters and the land owners, as it would hamper the municipality if they required to purchase. No. 1 railway had therefore to be left out, and after the opposition of the Taff Vale Railway had been heard, the Commissioners intimated that it was unwise to grant such a small bit of line as that proposed from Penarth to Ely Bridge, and the promoters withdrew their application.

Reading.—The Town Council on 2nd inst. adopted the following report of the Finance and General Purposes Committee:—"That the committee do recommend to the Council that an application be made to the Board of Trade for a provisional order in the next session of Parliament authorising the local authority to extend the existing tramways after they shall have been acquired by the local authority as follows, namely, from the terminus near the Cemetery to the South-Eastern Railway bridge in London Road and to St. Peter's Road, Earley Rise, and from the terminus near the barracks to the Pond House, and also authorising the local authority to work the tramways themselves and to use electricity and other mechanical power for working the same."—In the discussion Mr. Martin, chairman of the committee, said the reason why they did not propose any additional extension was because they had not decided on an important question, as to what their future traction should be, whether it should be electricity or a continuation of horse traction, or by compressed air or some other new traction which might crop up during the next two years. They would thus gain two years more experience, which he thought placed them at a decided advantage, instead of rushing into a scheme at the present moment and deciding off-hand what traction they would take up. In considering the question of traction, another element was the question of gauge, and if they decided on electric traction they would no doubt have to alter the gauge throughout the whole of the town, whether it be from east to west or north to south. They thought it much better to proceed by steps.—Mr. Wellman believed that the minds of most people were made up in favour of an electrical overhead scheme, and that they were convinced that it was no good waiting and sending a deputation all over the world to find out the best scheme. The example of those business men who had risked their own money in starting companies for laying down electric tramways ought to be good enough for them; anyhow, it was good enough for the large number of people of Reading. He believed, therefore, that their minds were made up to have a good and efficient service all over the town, and not only in the west and east, but to Caversham, Redlands, Whitley, Bath Road, and anywhere where there was a considerable population, it would be advisable and to their interest to extend the tramways. He felt sure that nothing short of a complete and efficient system would satisfy the town. They were at present a long way behind other towns, and if they simply stuck to the lines laid down by this meagre resolution

of the committee they would greatly disappoint the town.—Mr. Bonny said he was in possession of figures which went to prove that an outlay of £100,000 would be ample to provide a system of electric trams from the Pond House to Earley Rise, and from Whitley to Caversham. He had no doubt it would be a very profitable venture. Under the present miserable and wretched system the company paid a dividend of 7 per cent., and there was not the slightest doubt that they could pay more than that on an outlay of £100,000. He was informed by experts that that sum would pay all expenses of new equipment, new lines, and the whole cost of the installation of electrical plant. The report was adopted with only two dissentients.

Redditch.—The Redditch District Electric Traction Company, Limited, has just been registered, with £2,000 capital, to promote and obtain the necessary authority to make and maintain light electric railways and tramways in the counties of Worcester and Warwick or elsewhere.

Sheffield.—The Tramways Committee recommend that the British Thomson-Houston Company be requested to fit one truck of the 25 cars now on order with roller bearings of the Roller Bearings Company, and another with those of the Mossberg Company, and that the British Thomson-Houston Company be requested to construct the new trucks to allow of such bearings being put in, if the tests prove satisfactory. It is also recommended that the tender of the British Thomson-Houston Company, Limited, for the electric equipments and the Peckham trucks for the 13 cars on order from Messrs. Milnes & Co., at £433 6s. 8d. per car be accepted, also that the tender of the British Thomson-Houston Company, Limited, for 12 single-deck cars, including electrical equipment and trucks, at the sum of £617 16s. 8d. per car, be accepted.

Stourbridge.—A Dudley paper says that the British Electric Traction Company are pushing on well with the work connected with the conversion of the tramway from Stourbridge to Hart's Hill into an electric line, but nothing is yet being done as regards a start with the Kinver line.

Tipton.—At last week's Council meeting, when the report of the deputation to a West Bromwich conference on the tramway question was read, Councillor Doughty said that no other local authority was in the same position as themselves. Wednesbury had everything to gain by the trams, as had West Bromwich, and Dudley had already expressed the opinion that they would take the trams into their own hands. Darlaston only possessed a mile or more of trams. He thought they would sanction almost any scheme that might be put forward in order to retain Tipton. Trams were an absolute necessity, but in his opinion the overhead system was not satisfactory, and he thought if they could induce any company to lay down a cable or conduit system it would be an advantage to the public. He thought they could reasonably ask any new company formed to put down the conduit system of electricity. He seconded the adoption of the report, and this was agreed to.

York.—At Monday's City Council meeting, Alderman Agar, in moving the confirmation of the minutes of the Streets and Buildings Committee, referred to the refusal of the committee to allow the York Tramways Company the use of electrical power for the haulage of their cars. He said this action had been taken exception to, but he was satisfied that if those who took exception to it knew that the company would use that power by overhead wires suspended on standards, they would at once see that that would cause a great block in their narrow streets, and that the committee had done right.

TELEGRAPH AND TELEPHONE NOTES.

Hereford Telephones.—Increased facilities for telephonic communication have now been afforded by the National Telephone Company and the Post Office. The town is now connected with the trunk service.

Soudan Telegraphs.—A Reuter despatch dated Suakim, June 5th, says that the telegraph lines from there to Kassala and Berber are being splendidly laid. Bimbashi Manifold has left for the front, *vid* Cairo, after completing his work at this end. Of the line to Kassala 130 miles have been laid, and of that to Berber 30. Both lines are expected to be completed in three months.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1893 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Cyprus-Latakia	Feb. 10th, 1898 ...	...
Bolama-Bissao	April 12th, 1898 ...	...
Maranham-Para	„ 17th, 1898 ...	...
Hong Kong-Manila ...	... May 3rd, 1898 ...	...
Loanda-San Thomé	... June 3rd, 1898 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1898 ...	...
Cartagena-Barranquilla	... July 4th, 1896 ...	...
Saigon-Bangkok ...	... June 1st, 1898 ...	June 2nd, 1898.

Telephone Communication between Brussels and Manchester.—It is stated that some experiments were made on 6th inst. with the telephone between Manchester and Brussels, the operators at the two cities being put in direct communication with each other. Both land and sea wires had to be utilised, the wires running from Brussels through Courtrai and Lille to Calais, where they were connected with the London-Paris telephone cable under the Straits of Dover.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barnet.—June 24th. The Lighting Committee want tenders from firms willing to undertake such installation for lighting the district by electricity. Particulars at the Council offices, and see this week's "Official Notices."

Bethnal Green.—June 28th. The Board of Guardians invite tenders for supplying the necessary plant and installing the electric light at the new infirmary, Palestine Place. For particulars see our "Official Notices" this week.

Bournemouth.—June 20th. The Corporation is inviting tenders for the supply, &c., of cables, arc lamps, incandescent lamps, wiring, switchboards, fittings, &c.; also steam dynamo, &c. Particulars from the borough engineer, Mr. F. W. Lacey, also see our "Official Notices" May 27th.

Bulgaria.—June 27th. Some little time ago the municipal authorities of Sophia, Bulgaria, invited tenders for the concession for the electric lighting of the public streets of the city, and for the construction and working of an electric tramway. The authorities are again inviting tenders, until the 27th inst., for this concession, particulars of which may be obtained from above.

Bury St. Edmunds.—June 13th. The Corporation invites tenders for the supply and erection of Lancashire boilers, three 60-kw. steam dynamos, transformer and booster, accumulators, street mains, and various other machinery and apparatus for the electricity undertaking. Consulting engineer, Mr. F. H. Medhurst, 13, Victoria Street, S.W. See our "Official Notices" May 13th.

East London (Cape Colony).—June 28th. The Town Council is inviting tenders for erection of buildings and the supply of electric lighting machinery, electric tramcars, plant, rails, &c., and for their maintenance for six months from completion. Particulars from Messrs. Dyer & Dyer, 17, Aldermanbury, London, E.C., on payment of £5, repayable on the receipt of a *bonâ fide* tender.

Edinburgh.—June 14th. The Corporation wants tenders for the electric wiring of the police chambers (400 lamps). Particulars from the electrical engineer, Dewar Place, also see our "Official Notices" June 3rd.

Edinburgh.—June 14th. The Corporation wants tenders for the supply of cast-iron pipes, pavement boxes, and collars for joining earthenware casing. Particulars from the resident electrical engineer.

Llandudno.—June 16th. The District Council wants tenders for the supply of meters of various sizes for 12 months. See our "Official Notices" this week for details of sizes.

London.—June 21st. The London County Council is inviting tenders for engines, dynamos, accumulators, switchboards, feeders, distributors, and service mains and all accessories, to be fixed complete in buildings at the Crossness Outfall Works, near Erith, Kent. The L.C.C. also requires tenders for providing and fixing cables, wires, conductors, casing, pendants, brackets, and other fittings, columns, lanterns, lamps, switches, and switchboards, distributing boards, fuses, cut-outs, &c., necessary for the lighting by electricity of the Crossness pumping station and works, near Erith, Kent. Particulars of both contracts from the Engineer's Department, County Hall, Spring Gardens, S.W. See also our "Official Notices" May 27th.

Sheffield.—June 13th. The Tramway Committee is inviting tenders for the erection of an electric power station for its tramway scheme. Particulars from the City Surveyor.

Southampton.—June 20th. The Corporation invites tenders for the supply and erection of lamp columns, arc and incandescent lamps, automatic switches and fittings. Consulting engineers, Messrs. Kincaid, Waller & Manville. See our "Official Notices" June 3rd.

St. Pancras.—June 14th. The Vestry wants tenders for condensing plant, steam pipes, &c., for the Regent's Park electricity station. Particulars from the chief clerk, Electricity Department, 57, Pratt Street. See our "Official Notices" June 3rd.

Tynemouth.—June 20th. The Corporation wants tenders for the supply of steam dynamos, balancer and boosters, &c. Consulting engineers, Messrs. Lacey, Clirehugh & Sillar. See our "Official Notices" June 3rd, for particulars.

Victoria.—June 24th. The Council of the city of Hawthorne (Colony of Victoria, Australia) is inviting tenders for the supply and erection of buildings, boilers, engines, dynamos, transformers, mains, meters, arc lamps, poles; also running the plant for three years. See our "Official Notices" March 11th.

York.—June 24th. The Corporation is inviting tenders for the erection of an electric light station. Particulars from the City engineer, Guildhall.

CLOSED.

Aberdeen.—For electric wiring and fitting work at the new building at the bathing station the Council has given the contract to Mr. R. Botting at £117.

Balmoral Castle.—The Electric Construction Company, Bushbury, near Wolverhampton, are to supply the dynamos necessary for the installation of the electric light at Balmoral Castle.

Dundee.—The Electric Committee has accepted the following tenders for supply of steam coal for the electricity works:—Robert Taylor, 1,500 tons of Wallsend diamond nuts (Aitken) at 9s. per ton; W. Taylor & Co., 1,500 tons of No. 1 Hamilton small coal (Eddlewood ell), at 8s. 2d. per ton—all delivered at the electric lighting station.

Belfast.—After considering the tenders submitted for the wiring of the new police office and cells, the Corporation has given the contract to Mr. W. H. Drennan.

Harrogate.—The Town Council has accepted the tender of Mr. Steinthal for ornamental electric lamps for lighting the Spa and Gardens at £189.

West Ham.—Messrs. Veritys' tender for the electric fittings for West Ham Corporation has been accepted. There were 11 competitors. Messrs. Veritys' quotation, which was not the lowest, was for the supply of the fittings at 5 per cent. below the schedule price.

FORTHCOMING EVENTS.

1898.

Friday and Saturday, June 10th and 11th.—Municipal Electrical Association Conference continued.

Friday, June 10th, at 8.30 p.m.—The Institution of Junior Engineers at the Westminster Palace Hotel. Special meeting to welcome Sir T. Salter Pyne, C.S.I., honorary member of the Institution.

At 5 p.m.—Physical Society. Agenda:—1. Exhibition of a Model illustrating Dr. Max Meyer's new theory of Audition, by Prof. S. P. Thompson, F.R.S.; 2. "Attenuation of Electric Waves along a line of negligible Leakage," by E. H. Barton, D.Sc; 3. "Diffusion Convection," by A. Griffiths, B.Sc.

Thursday, June 16th, at 9 p.m.—Institution of Electrical Engineers' Conversazione at the National History Museum, South Kensington.

At 8 p.m.—Chemical Society, Burlington House. Papers to be read:—"Preparation of a Standard Acid Solution by Direct Absorption of Hydrogen Chloride," by G. T. Moody, D.Sc.; "Researches on the Terpenes. III.—Halogen Derivatives of Fenchene and their Reactions," by J. A. Gardner, M.A., and G. B. Cockburn, B.A.; "Researches on the Terpenes. IV.—On the Oxidation of Fenchene," by J. A. Gardner, M.A., and J. B. Cockburn, B.A. Ballot for the election of Fellows.

NOTES.

The Municipals' Dinner.—The dinner of the Municipal Electrical Association was held on Wednesday evening at the Holborn Restaurant.

Errata.—On page 751 of last week's issue, line 17 right-hand column, for "torque" read "tongue;" and on page 755, line 11, for "with resistances *and* effect," read *an* effect.

On page 752 of last week's Electrical Review an error arises in Mr. Apps's Röntgen Society paper on "A New Induction Coil." In line 35, for 4½ inches read 44½ inches.

Lighthouse Illumination.—An important alteration is to be carried out in connection with the revolving light at Cape Gris Nez. A new lighthouse is to be erected, much higher than the present one, so that the light will be seen at a distance of 48 miles. It is to be an electric light, having a white flash every second, and the candle-power will be no less than 3 millions. It is computed that the light will pierce the fog for a distance of 16 miles.

Machinery Interviews. — *Machinery*, of South Africa, is one of those papers which goes the length of publishing so-called interviews with machinery builders. A recent number contains one such with Mr. Norbury, of Galloway's, Limited, the Manchester boiler makers, which is in the worst possible style of interview, being little else than a clumsy vehicle for carrying certain statistics as to Messrs. Galloway's works, which would have been far better described in a regular descriptive article and of more interest, besides giving less prominence to a list of exhibition awards as tedious as the interminable list of things which constitutes the poetry of Walt Whitman. We do not think that the views propounded as to steam jacketting will meet the approval of many engineers. If anyone has found the steam jacket to be as described simply a means of robbing Peter to pay Paul, we should advise a reform in the construction of the jacket and a perusal of Fletcher's little book on the steam jacket. We are glad to find nevertheless that Mr. Norbury has been to Johannesburg, and think that other leading English firms would do well to send out representatives capable of speaking with authority, in order to look up business, not merely in the Transvaal but in other countries. It is not necessary they should all be interviewed.

The War and the Cables.—The *Times* correspondence on the cutting of the cables in war time—which we have already reproduced in the Electrical Review—is continued by Mr. Charles Bright, as follows:—

With the authority of experience, Mr. Parsoné appears to have been the first to remind the public that more than one cable owned by a company of neutral nationality has been interrupted in the course of warfare. Without desiring to take up your space by a disquisition on the morality, or otherwise, of cutting neutral cables, or on the question of indemnity claimable, perhaps I might remark that, in my opinion, a useful purpose has been served, if only in exemplifying what we may actually expect in the event of our country being at war with another European Power. Surely a consideration of the prospects points, Sir, to the necessity—aye, urgent necessity—of a system of cables connecting the entire British Empire by direct and independent means—*i.e.*, without touching on foreign soil. In the event of a permanent and reliable understanding being arrived at with our American cousins, the United States would not require to be regarded as foreign territory; and if, for certain purposes, a further alliance, including Japan, were agreed to, two Pacific cable schemes might be united in one. Reciprocally, a telegraphic clause would be one of the most important items in any convention constituting an Anglo-American alliance and Customs union, whether Japan be also allied with us for strategic and trade purposes or not. Such a convention would tend to ensure the naval supremacy of the English-speaking world in the Pacific, and would render us independent of the good offices of our European neighbours. It is known that the Americans are taking active steps in the direction of a cable from San Francisco to Japan. If the understanding here referred to were brought about, a comparatively short branch from the above to Australia would also embody every element of the all-British line lately considered by the Colonial Office. My remarks are, of course, rather from the national point of view than from that of a shareholder in existing cable systems. Moreover, they do not apply to the project for an all-British line to the Cape and Australia *vid* Gibraltar and various important naval stations—an admirable project in itself, so far as it goes. I am glad to think, Sir, that you recognise the entire subject as one of vital importance just now, and I trust that, considering the strained condition of European politics, the matter will be thoroughly gone into.

Mr. T. E. Holland replies to the above letter, also that of Mr. Parsoné, in the following terms:—

Will you allow me to refer in a few words to the interesting letters upon the subject of submarine cables which have been addressed to you by Mr. Parsoné and Mr. Charles Bright? In asserting that "the question as to the legitimacy of cable-cutting is covered by no precedent" I had no intention of denying that belligerent interference with cables had ever occurred. International precedents are made by diplomatic action (or deliberate inaction) with reference to facts, not by those facts themselves. To the best of my belief no case of cable-cutting has ever been made matter of diplomatic representation, and I understand Mr. Parsoné to admit that no claim in respect of damage to cables was presented to the mixed Commission appointed under the Convention of 1883 between Great Britain and Chili.

In the course of his able address upon "Belligerents and Neutrals," reported in your issue of this morning, I observe that Mr. Macdonell suggests that the Institut de Droit International might usefully study the question of cables in time of war. It may, therefore, be well to state that this service has already been rendered. The Institut, at its Paris meeting in 1878, appointed a committee, of which M. Renault was chairman, to consider the whole subject of the protection of cables, both in peace and in war; and at its Brussels meeting, in 1879, carefully discussed the exhaustive report of its committee, and voted certain "conclusions," notably the following:—

"Le câble télégraphique sous-marin qui unit deux territoires neutres est inviolable.

"Il est à désirer, quand les communications télégraphiques doivent

cesser par suite de l'état de guerre, que l'on se borne aux mesures strictement nécessaires pour empêcher l'usage du câble, et qu'il soit mis fin à ces mesures, on que l'on en répare les consequences, aussitôt que le permettra la cessation des hostilités."

It was in no small measure due to the initiative of the Institut that diplomatic conferences were held at Paris, which in 1882 produced a draft convention for the protection of cables, not restricted in its operation to time of peace; and in 1884 the actual convention, which is so restricted.

It may not be generally known that in 1864, before the difficulties of the subject were thoroughly appreciated, a convention was signed, though it never became operative, by which Brazil, Hayti, Italy and Portugal, undertook to recognise the "neutrality" in time of war of a cable to be laid by one Balestrini. So, in 1889, the United States were desirous of concluding a general convention which should assimilate the destruction of cables in the high seas to piracy, and should continue to be in force in time of war. The Brussels conference of 1874 avoided any mention of "câbles sous-marins."

The moral of all that has been written upon this subject is obviously that drawn by Mr. Charles Bright, viz., "the urgent necessity of a system of cables connecting the British Empire by direct and independent means, *i.e.*, without touching on foreign soil."

A New York telegram says that despatches from Santiago announce that the steamer *Adrian*, convoyed by the gunboat *Dolphin*, succeeded in cutting two of the three cables connecting Cuba with Jamaica and Hayti on Friday last. The cable cutting has been done with the tacit approval of England and France, and no complications are likely to ensue.

Motor Starters.—The *Electrical World* recently said regarding motor starters:—

What is ordinarily known as an automatic motor starter might better be termed a motor stopper, the name really signifying a device by which, when the current is shut off, the full resistance of the starting rheostat is inserted in the circuit. An ideal automatic motor controlling mechanism would consist of a device so arranged that when the main switch is closed on the motor the resistance arm would move gradually from resistance all in to resistance all out, at which position it would remain until the current was turned off or the motor was overloaded, in either of which cases it should again insert full resistance, and in case of overload preferably open the armature circuit. No such device is at present on the market.

Mr. F. E. Herdman, of Milwaukee, Wis., has written to our contemporary on the matter, as follows:—

I built an automatic starter, similar to the one you describe as an ideal starter, over a year ago, and the same has been regularly manufactured and on the market since that time. This starter is operated by simply closing a double-pole knife-switch to the main circuit, this action deflecting a strong spring which operates the rheostat contacts, cutting out the resistance at a speed determined by a pneumatic dash-pot. When the circuit is open, the resistance is automatically thrown into the circuit. The starter is supplied with an under voltage and an overload release, the action of either opening the double-pole knife-switch. The main switch cannot be closed unless the resistance is all in circuit with the motor, and when the knife-switch is closed the resistance will not be cut out of circuit unless the current flows through the motor, and the knife-switch would not stay closed when the hand is taken from it unless such a current existed.

Our contemporary adds that the starter described by Mr. Herdman fulfils the requirements mentioned as some of those of an ideal motor controlling mechanism.

The Heating Capacity of Wood.—An American exchange says that a writer in the *Staats Zeitung* corrects a very common supposition in regard to the heating capacity of wood, the most notable fact in the case being that such a practical and easily demonstrable error should so long have prevailed, namely, that the heating capacity of hard wood is greater than that of soft wood. The fact, as ascertained by repeated determinations, is that the greatest heating power is possessed by one of the softest varieties of such material, viz., the linden. Taking its heating capacity by the unit, the second best heater is also a soft wood—fir, with 0·99 heating power; next follow the elm and pine, with 0·98; willow, chestnut, larch, with 0·97; maple and spruce fir, with 0·96; black poplar, with 0·95; alder and white birch, with 0·94 only; then comes the hard oak, with 0·92; the locust and the white beech, with 0·91; and the red beech, with 0·90. These examples leave no doubt of the general fact that hard wood heats the least.

Röntgen Society.—At the meeting of this society held at 11, Chandos Street, Cavendish Square, W., on Tuesday, 7th inst., papers were read by Mr. T. C. Porter on "Work on the X Rays," and Mr. A. A. Campbell Swinton, on "A Pin-hole Röntgen Ray Camera and Its Applications."

Mr. John Brooke Goodman.—Mr. John Brooke Goodman, a young electrician in the employ of the Electric Traction Company, at the works of the Central London Railway, now in course of construction between the City and Shepherd's Bush, lost his life by a distressing accident on June 1st. He was assistant superintendent of the electric lighting arrangements in the tunnels, &c., and on the day in question he was at the Oxford Circus station, where there is a small installation of two 200-volt, 100-ampere, 800 revolution dynamos, belted to high-speed vertical engines. The belt of the left-hand set had come off and had been replaced, the engine being again started at about quarter speed. Although the precise cause of the accident will never be known, it seems quite certain that when going round to look at the belt while the engineer was altering the tension screws, Mr. Goodman slipped or stumbled, lurched on to the pulley of the dynamo and was then thrown with terrible force against the wooden wall of the shed, rebounding on to the second dynamo with which his head came into such violent contact that his skull was fractured, death resulting within a minute or two. Mr. John Brooke Goodman was the third son of Mr. Edward John Goodman, assistant editor of the *Daily Telegraph*. He was born on December 20th, 1874, and was thus only 23 years of age. He had only been about six weeks in the employ of the Electric Traction Company at the time of the accident. His early death has cut short a very promising career. Industrious, energetic, and well informed in the technical and practical phases of electrical engineering, he would undoubtedly have risen to a high position in his profession.

Another New Element.—Prof. Ramsay, who several years ago, in conjunction with Lord Rayleigh, discovered argon, has succeeded in eliminating from the atmosphere a new gas. This elementary substance, which has been named crypton, or "concealed," is obtained by the evaporation of large quantities of liquid air. The residue is a hitherto unknown gas, transparent, heavier than argon, and, like that element, inactive. Crypton is present in the atmosphere in the proportion of 1 to 20,000 parts. The chief lines of the spectrum are green and yellow, the yellow being nearly coincident with the helium yellow line D 3.

The Paris correspondent of the *Standard* says that at Monday's sitting of the Academy of Sciences, M. Berthelot read a communication relating to the new constituent of atmospheric air, the discovery of which is due to the investigations and experiments of Prof. Ramsay and Mr. Morris W. Travers. These gentlemen lately received from Dr. Hampson 750 cubic centimetres of liquid air, which they reduced by evaporation to 10 cubic centimetres, and collected in a tube the gas furnished by the residue. This gas was deprived of its oxygen by the help of metallic copper, of its nitrogen by the action of the electric spark, and of oxygen after that by a mixture of magnesium and pure lime. This operation effected, there remained 26 cubic centimetres of a gas which presented, besides the weakly-defined spectrum of argon, an additional spectrum till then unknown. It was characterised by two exceedingly brilliant lines, one being almost identical with D 3. The other, green, may be compared in intensity with the green line of helium. Its wave length was 5,566·3. Another slightly weaker gave 5,557·3. The density of the gas was approximately 22·5, that of oxygen being 16. According to the velocity of sound, the ratio of specific calories is 1·666, the same as that of argon and helium. It therefore follows that the new gas is monatomic, and constitutes an element. These facts go to prove that the atmosphere contains a hitherto unknown gas heavier than argon, with a characteristic spectrum, less volatile than nitrogen, oxygen, and argon. Messrs. Ramsay and Travers give crypton as the name for this new gas. The position in the periodical table it is not possible to determine in an absolute manner. They, however, hazard the conjecture that the pure gas has a density of 40, and an atomic weight of 80, and that it may be classed with helium. Those gentlemen are continuing their investigations, and preparing a larger quantity of the gas to that end. M. Berthelot, who received a small supply of the new gas in a Fluckyer tube, has verified the existence of the new lines by means of his spectroscope.

The Parliamentary Electrical Energy Committee.—It is understood, says the *Times*, that the Joint Committee of Lords and Commons upon Electrical Energy (Generating Stations and Supply) have arrived at the conclusion that the proved public advantages of electrical energy in the generation of light and power warrant the granting to undertakers of compulsory powers for acquiring sites for generating stations and lands or easements for pipes and mains therefrom. The Committee recommend that provision be made for the granting of these powers in the provisional orders of the Board of Trade, subject to confirmation by Parliament, it being pointed out that such provision would facilitate a continuance of the existing practice according to which more or less uniform conditions under which undertakers are to work are provisionally settled by the Board of Trade. Procedure by private Bill should, the Committee hold, be reserved, as at present, for exceptional cases. As to the bodies which should be entrusted with these powers, the committee suggest either local authorities or incorporated companies (whether the incorporation be by special Act of Parliament or provisional order, or under the Companies Acts). With respect to liability for nuisance, the committee are of opinion that where the site for a generating station is acquired under compulsory powers, and is specified in the provisional order or special Act, the undertakers should not be subjected to any further liability than that which, according to Lord Blackburn ("Geddis *v.* Bann Reservoir," 3 App. Cas., 455), is imposed by the common law in the case of persons exercising statutory powers and duties. On the other hand, where the site for a generating station is acquired by agreement, they think the undertakers ought to be subject to the liability imposed by the common law. The committee explain that the several Bills now pending in Parliament, in which effect is proposed to be given to new developments of the electrical industry have been brought to their notice, but they have not considered them in detail nor taken any evidence upon them. They have treated them only incidentally as showing the lines upon which the industry is likely to expand. They have laid down the general principles which they suggest should guide Parliament and the Board of Trade, but whether those principles should, in whole or in part, be applied, and whether any, and what, special conditions should be imposed, must of course be decided in each individual case according to its merits. The committee express the view that compulsory powers may properly be given even where the proposed site is not within the area of supply; and in this connection they also agree that the laying of mains should be permitted from the generating station to the boundaries of the area of supply.

Bi-Metallic Wire on the Pennsylvania Railway Telegraph System.—An American exchange says that Mr. A. M. Schoyer, superintendent of telegraph, Pennsylvania lines west of Pittsburg, about a year ago placed bi-metallic wire in service on several of the branch lines of this great railway system in and around Pittsburg, and because of the very satisfactory service which that wire rendered, he has recently introduced bi-metallic wire on the main line of the road between Pittsburg and Columbus, the size of the wire being No. 9 B. & S. gauge. Our contemporary adds that the splendid position of the Pennsylvania system to-day shows conclusively that the utmost care is exercised in conducting all branches of its business, and because of the excellent service which that system renders to the public, it necessarily follows that any material which is used by it receives the stamp of approval of a company which is second to none. In view of this use it can be said that bi-metallic wire is now a standard type of wire for overhead construction.

War Fatalities.—From the New York *Electrical Engineer* we learn with regret that two of the Edison Company's electricians were working down the Bay laying torpedoes off Sandy Hook from a small boat, when they were run down by a French ship and drowned. These are the first war victims in the vicinity of New York. Our contemporary remarks that the sad incident is but a further proof of the active part that electricity is playing in the present war, and that pensions should be awarded to the families of the two men.

Royal Institution.—At last Monday's meeting the special thanks of the members were returned for the following donations to the fund for the promotion of experimental research at low temperatures:—Messrs. G. J. Romanes, £5; Sir Frederick Bramwell, £100; Prof. Dewar, £100; Dr. Ludwig Mond, £200; Charles Hawksley, Esq., £100; Sir David Salomons, Bart., £21; Dr. Rudolph Messel, £100.

The Royal Society.—Among the papers down for reading yesterday was one by Prof. W. Ramsay, F.R.S., and Morris H. Travers, "On a New Constituent of Atmospheric Air," and one by Mr. J. E. Petavel, "On the Heat Dissipated by a Platinum Surface at High Temperatures."

Presentation.—On Tuesday last, the staff of Messrs. Crompton & Co., Limited, entertained Mr. Chamen, Corporation electrical engineer at Glasgow, at dinner at the White Hart Hotel, Chelmsford, and presented him with a gold watch and chain and an illuminated address. Mr. Chamen was, previous to his appointment at Glasgow, engineer-in-chief of Messrs. Crompton's contract department.

Shock Fatality.—On May 19th, a young man in the employ of the United States Electric Lighting Company, at Washington, met his death under circumstances somewhat similar to those attending the victim of the Chelmsford accident. He was attending to the wires at a manhole when he received the full force of the current, and all efforts to restore him to consciousness were of no avail. The deceased was one of the best workmen the company had and was a thoroughly experienced hand. The affair was purely an accident, for deceased had given instructions for the current to be switched on to the cables from the station, but it was on sooner than he anticipated, he not having finished making the connection.

Technical Education.—The Kingston-on-Thames Technical Education Committee (under the Surrey County Council) has decided to hold a class for electric lighting during next winter, the pupils to receive object lessons at the Corporation's electric lighting works, established two years ago.

"Submarine Telegraphs."—The Queen has been pleased to accept a copy of the recent work on "Submarine Telegraphs," by Mr. Charles Bright, F.R.S.E., and of the *brochure* entitled "Science and Engineering during the Victorian Era," by the same author.

Personal.—We are glad to be able to announce that Mr. H. Hirst is rapidly recovering from the effects of the operation recently performed on him, and that he hopes soon to get up from his sick couch.

On Tuesday the Londonderry Corporation appointed Mr. Robert Valentine Macrory (late of Messrs. Siemens Bros. and Co.) to the position of Electrical Engineer for the City. There were 51 candidates.

NEW COMPANIES REGISTERED.

Limerick Electric Tramway Company, Limited (2,238).—Registered in Dublin May 2nd, with capital £2,000 in £1 shares, to equip and to maintain and work by electricity, steam, horse, or other mechanical power, all tramways belonging to the company, or in which the company may be interested, and to carry on the business of tramway, railway, omnibus, and van proprietors, &c. The subscribers are:—W. H. Wilson, 37 College Green, Dublin, stockbroker, one share; N. McGarvie, 19, Killeen Road, Rathmines, Dublin, stockbroker's clerk, one share; J. A Wilson, 37, College Green, Dublin, stockbroker, one share; W. Butler, 47, Goldsmith Street, Dublin, accountant, one share; J. Chambre, Commercial Buildings, Dublin, merchant, one share; H. F. Fuller, 8, Wellington Road, Dublin, M.Inst.C.E., five shares; G. W. Fitzgerald, 65, Haddington Road, Dublin, civil engineer, one share. The number of directors is not to be less than two nor more than seven. The subscribers are to appoint the first. Qualification, £50; remuneration as fixed by the company. Registered by T. W. Hardman & Sons, 14, Molesworth Street, Dublin. Registered office, 22, Mason Street, Dublin.

T. F. Braime & Co., Ltd. (57,524).—Registered May 26th, with capital £20,000 in £1 shares, to acquire the business carried on by T. F. Braime at the Northern Works, St. Helen's Street, Hunslet, Leeds, and to carry on the business of mechanical, electrical, and general engineers, stampers, pressers, piercers, brass founders and finishers, tinners, coppersmiths, &c. The subscribers (with one share each) are:—T. F. Braime, 148, Chapeltown Road, Leeds, engineer; Mrs. L. Braime, 148, Chapeltown Road, Leeds; J. H. Braime, Elm Cottages, Rothwell, near Leeds, engineer; Mrs. M. Braime, Elm Cottages, Rothwell, near Leeds; Miss M. E. Braime, Elm Cottages, Rothwell, near Leeds; G. Crowther, The Ridge, Bingley, chartered accountant; A. W. Waide, Methley, Leeds, farmer. The number of directors is not to be less than two nor more than five; the first are T. F. Braime, J. H. Braime, and A. W. Waide. Qualification, £200. Remuneration as fixed by the company. Registered by Waterlow Bros. & Layton, Ltd., Birchin Lane, E.C.

Redditch District Electric Traction Company, Limited (57,527).—Registered May 26th, with capital £2,000 in £10 shares, to promote and obtain the necessary authority to make and maintain light railways and tramways in the counties of Worcester and Warwick, or elsewhere, to make and maintain any such light railways and tramways, and to supply electric light, heat and motive power. The subscribers (with one share each) are:—E. Horton, The Grange, Prescot, near Walsall, manufacturer; J. J. Gittings, Glenthorn, Birchfield, Birmingham, manufacturer; W. J. Kershaw, 34, Waterloo Street, Birmingham, chartered accountant; H. P. Butt, 73, Thornhill Road, Handsworth, clerk; R. P. Dodd, 48, Kingscote Road, Edgbaston, Birmingham, civil engineer; R. Green, Silvermere, Clarence Road, King's Heath, civil engineer; C. H. Hales, 138, Oldfield Road, Balsall Heath, clerk. Table "A" mainly applies. Registered office, 37, Waterloo Street, Birmingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Metropolitan Electric Supply Company, Limited (25,395).—This company's annual return was filed on April 27th, when 62,400 ordinary and 100 founders' shares were taken up out of a capital of £1,000,000 in £10 shares. 2,032 are considered as paid, and £10 per share has been called and paid on the remaining 60,468 shares.

Bournemouth and Poole Electricity Supply Company, Limited (55,189).—This company's statutory return was filed on May 20th. The capital is £150,000 in £10 shares (7,500 preference). 6,000 of each class have been taken up, £10 per share has been called, £119,680 has been paid, and £320 is in arrears.

Oldham, Ashton, and Hyde Electric Tramway, Limited (55,318).—This company's statutory return was filed on April 27th. The whole capital of £80,000 in £10 shares (4,000 preference), has been taken up, and £4 per share has been called. £31,230 has been paid, £770 is in arrears, and £120 has been received in advance of calls.

County of London and Brush Provincial Electric Lighting Company, Limited (34,320).—This company's annual return was filed on May 20th. The capital is £800,000 in £10 shares (40,000 preference). 40,000 ordinary and 20,000 preference have been taken up. £10 per share has been called on 30,000 ordinary and 20,000 preference, and £2 per share has been called on 10,000 ordinary. £519,880 (including £40 in advance of calls) has been paid, and £160 is in arrears.

Willans & Robinson, Limited (40,660).—This company's annual return was filed on April 22nd. The capital of £300,000 in £5 shares (30,000 preference) has been taken up, and 14,463 preference and 14,462 ordinary are considered as paid; £5 per share has been called on 12,537 preference and 12,538 ordinary, and £1 per share has been called on 3,000 preference and 2,997 ordinary; £131,372 has been paid, and £3 is in arrears.

Electric Street Car Manufacturing Syndicate, Limited (55,080).—This company's statutory return was filed on April 22nd. The capital is £25,000 in £1 shares, of which 7,130 have been taken up. 10s. per share has been called, and £3,552 10s. has been paid, leaving £12 10s in arrears.

CITY NOTES.

Great Northern and City Railway Company.

This week the prospectus of this company has been before the public, inviting applications for £780,000 in 4 per cent. preferred ordinary "A" £10 shares at par, and £780,000 5 per cent. deferred ordinary "B" £10 shares at par. Interest at 3 per cent. per annum will be paid half-yearly on May 1st and November 1st, during construction, on both "A" and "B" shares, as authorised by Parliament, on amount paid up from time to time. The contractors, Messrs. S. Pearson & Son, Limited, guarantee the payment of a minimum interest of 4 per cent. per annum on the "A" shares, and of 3 per cent. per annum on the "B" shares during the period they work the railway, not exceeding three years after opening of the line.

The directors are Sir Charles Scotter, chairman, Sir Allen Sarle, the Earl of Lauderdale, Colonel R. Williams, M.P., Sir Francis Knollys, K.C.M.G., K.C.B. Sir Douglas Fox and Mr. Francis Fox are engineers. Secretary, Mr. H. Barrow Doo, 18, Eldon Street, Finsbury, E.C.

The Great Northern and City Railway (about three miles in length), in direct connection with the Great Northern Railway, will afford a short through communication between Finsbury Park station, where the various suburban lines of the Great Northern Railway Company converge, and Moorgate Street, in the City of London. This railway, with three intermediate stations at Drayton Park, Essex Road, and Old Street, will provide a frequent and convenient railway service for the densely populated district through which the railway will pass, and will thus fulfil the double purpose of serving a large local traffic, and of furnishing the Great Northern Railway system with a City terminus for its rapidly growing suburban traffic. The motive power will be electricity; but this railway will differ from other electric railways, in that both tunnels will be 16 feet in diameter, and will take the Great Northern Railway Company's heaviest suburban trains, consisting of 11 vehicles, with a seating capacity of 500 passengers. The journey will occupy 12 minutes.

The directors estimate the minimum annual revenue as follows:—

Local traffic:—	
At the low estimate of 10,500,000 passengers, which is less than 4,000,000 passengers per mile, at an average of only 2d. per passenger	£87,500
Local season-ticket holders, 10 per cent. of local receipts	8,750
Through traffic:—	
Assumed for first three years' working at only 25 per cent. above the Great Northern Company's guaranteed minimum	25,000
Sundry receipts:—	
Interest payable by Great Northern Railway Company, parcels, rents, advertisements, &c.	5,000
	£126,250
Less working expenses, say, 40 per cent., on local traffic, and 25 per cent. on the Great Northern through traffic	44,750
Net revenue	£81,500

The prospectus says that recent improvements in electric working prove that 40 per cent. is a liberal allowance for working expenses.

To pay interest at 4 per cent. on debenture stock of £520,000, and on preferred ordinary shares of £780,000, a net revenue will be required of £52,000.

The local traffic is calculated on a daily service of only 125 trains each way, upon which the carrying capacity will be equal to nearly four times the number of passengers assumed.

It is mentioned that the Metropolitan Railway runs daily through King's Cross 265 trains each way, the Metropolitan District 278 trains each way through Victoria, and the South London Electric Railway 220 trains each way for its purely local traffic.

The company has entered into a contract for the amount of the share and debenture capital of the company with Messrs. S. Pearson and Son, Limited, of Westminster, the well-known contractors, for the construction and equipment of the railway and works, in accordance with the Company's Acts, including land, buildings, rolling stock, electrical installation, motors, &c., with all Parliamentary, legal, engineering, administration, and other liabilities and expenses whatsoever during construction, including the payment of interest. The contractors assume all risks of compensation and damage by tunnelling or otherwise, and the company will enter upon a completed line, fully equipped with rolling stock, and in working order. Messrs. Pearson have entered into an agreement to work the railway for a period of three years after completion, the directors reserving to themselves the right to take over the working at any time at one month's notice.

The list opened on Tuesday and closed on Thursday.

London Electric Supply Corporation.

An extraordinary general meeting of this corporation was held on Tuesday at the City Terminus Hotel for the purpose of considering and, if thought fit, passing the following resolution: "That the capital of the company be reduced from £1,250,000, divided into 200,000 ordinary shares of £5 each and 50,000 preference shares of £5 each, to £850,000, divided into 200,000 ordinary shares of £3 each, and 50,000 preference shares of £5 each, and that such reduction be effected by cancelling capital which has been lost, or is unrepresented by available assets to the extent of £2 per share on each of the 111,000 ordinary shares which have been issued and are now outstanding, and by reducing the nominal amount of all the said ordinary shares from £5 to £3 each."

Lord Wantage, who was voted to the chair, said there had been a small but increasing profit every year since the date of the receiver's appointment. The working for the year 1897 showed a profit of £16,586, being more than double that of 1896. Their lamp connec-

tions showed a corresponding increase, for whereas in 1896 the numbers were 106,474, in 1897 they had increased to 123,730, or 17,256 increase for the year—a rate of progress equal to nearly 20 per cent. This favourable condition had been reflected in the value of the company's shares. It was 12 months since he last addressed the shareholders, and on that occasion they asked him to carry on the business for another year. He thought the shareholders would agree with him that the time had now arrived when the receiver should retire, and that the company should resume the possession after a break of four years. It was owing to the careful, economical, and skilful management of the receiver that the company had been saved, and was now in a prosperous condition. It was proposed that the whole board of directors should retire, leaving it in the hands of the shareholders to appoint a new board. Though it was not proposed to make any large changes in the constitution of the company, so far as the number of directors was concerned, he thought it was desirable that they should not fill up all the vacancies on the board at once, in case it might be found convenient to bring in other persons who would assist in the development of the business. He considered they should only elect four directors. The chairman then read a long report made by Mr. Bain, the receiver, on the affairs of the company. He concluded by moving the adoption of the resolution, which was seconded by Mr. Pyke, and unanimously agreed to.

A further resolution was afterwards passed altering the articles of association in order to conform with the requirements of the Stock Exchange with a view to obtaining a quotation for the company's stocks.

The following were then elected to act as the board of directors:—Lord Wantage, the Earl of Crawford, and Mr. R. S. Bain.

The Western and Brazilian Telegraph Company, Limited.

The report of the directors to be presented at the thirty-fifth ordinary general meeting of the company, held on Thursday, June 9th, at Winchester House, states that the total earnings amount to £72,332 9s. 10d., as against £71,315 12s. 2d., showing an increase of £1,016 17s. 8d. compared with the half-year to December 31st, 1896. The working expenses amount to £37,774 1s. 11d, as against £38,160 19s. 4d., a decrease of £386 17s. 5d. Including the amount brought forward from June 30th, 1897 (£3,867 15s. 2d.), and the dividend received upon the shares held in the "Platino" Company, the balance to the credit of the revenue account is £49,520 3s. 1d., from which has been deducted £8,060 8s. 4d. for interest on debentures and debenture stock, £2,159 12s. 4d. has been invested on account of the debenture stock redemption fund, and £5,000 placed to reserve fund, leaving a balance of £34,300 2s. 5d. The directors now recommend the payment of 6s. 9d. per share, free of income-tax, for the half-year on the ordinary shares, making, with the dividend paid in November last, £3 5s. per cent. for the year, leaving a balance of £1,428 5s. 11d. to be carried forward. In the case of shares which have been divided into "preferred" and "deferred," the 6s. 9d. per share now recommended will be payable, viz.: 6s. to the "preferred" shareholders (making up the full dividend of £5 per cent. on these shares to December 31st, 1897), and 9d. per share to the deferred shareholders. The loss on exchange during the half-year has been diminished owing to the additional collection on international traffic which came into force on July 1st, but the rate of exchange has still fallen. The receipts of the current half-year show a considerable improvement upon those for the corresponding period of 1897. Negotiations for closer working between this company and the Brazilian Submarine Telegraph Company, Limited, have been in progress, and an agreement will shortly be submitted to you. The ninth annual drawing of the "A" and "B" debentures took place at the company's offices on January 17th last, in the presence of Mr. H. de Meray, notary public, when debentures amounting to £18,000 were drawn; of these £8,000 "A" and £9,300 "B" had already been exchanged for debenture stock and the balance, viz., £700 "B" debentures have since been paid off at par. The dividend warrants will be posted on June 9th, 1898. The retiring directors are Mr. W. S. Andrews and Lord Richard H. Browne, who offer themselves for re-election. The directors report, with much regret, the death of their late colleague, Major Wood.

The auditors, Messrs. Turquand, Youngs, Bishop and Clarke, retire, and are eligible for re-election.

The general meeting of this company was held at Winchester House yesterday, Mr. W. S. Andrews presiding. The negotiations for closer working between this company and the Brazilian Submarine Company are not yet completed. They are progressing satisfactorily and pretty actively, and, it is believed, will result successfully, the results being welcome to the Governments and the public and the companies. Of course, nowadays, it was necessary to do things which were agreeable all round. He asked them not to put any questions to him regarding the subject. The report was adopted We shall print a longer report of the meeting next week.

The Metropolitan Electric Supply Company, Limited.

The following circular has been issued:—

Sir or Madam,—You will receive herewith a notice of an extraordinary general meeting, which has been summoned to consider a scheme with reference to the alteration of the founders' shares, and the practical consolidation thereof with the ordinary shares of the company, and also, if thought fit, of passing a resolution approving an agreement, a draft of which will be submitted to the meeting, whereby the founders' shareholders will have their founders' shares converted into ordinary shares, and in consideration of so doing, will have an option of subscribing for 225 ordinary shares at par for each founders' share held by them.

Though your directors are prepared to advise the adoption of this scheme, and the passing of the said resolution, they recognise that the shareholders may wish for some explanation why the board are now prepared to recommend a settlement more in favour of the founders' shareholders than that originally offered by the board, and which was referred to by the chairman at the annual general meeting.

The board appreciate that the compensation contemplated by the proposed agreement appears a large one, but they believe it will be warranted by the advantages which will accrue to the whole body of shareholders by the surrender of the special rights attaching to the founders' shares.

At the annual meeting the shareholders expressed their unanimous approval of the policy of the board in purchasing a freehold site at Willesden, and the erection thereon of a large generating station. These works involve an early issue of capital, but as to the terms of such an issue the interests of the holders of the founders' shares and of the ordinary shareholders in the company are directly divergent.

Another, and perhaps a more cogent reason, exists in the necessity of creating a strong reserve fund, in doing which the directors are hampered both by express prohibitions introduced into the articles in the interests of the founders' shares, and also by the consideration that if those reserve funds were formed out of profits, which would otherwise be divisible amongst the holders of ordinary shares, they might, when formed, be claimed as to one-half by the holders of the founders' shares.

It seemed impossible, in the face of these difficulties, to avoid a litigation, which would certainly have caused the company much embarrassment, by delaying the issue of the new capital.

It was, moreover, apparent that a similar opportunity of extinguishing the rights of the founders' shares would, in all probability, never occur again, and the directors felt bound by the repeated pledges given to the ordinary shareholders, to spare no effort in getting rid of the founders' shares, and placing all the shareholders of the company on an equal footing.

The extraordinary general meeting called to consider the above question was held at Winchester House on Tuesday last, Sir Eyre Massey Shaw in the chair.

The Chairman said the circular fully explained the reasons for the meeting. When he met them last there appeared to be no possibility of coming to terms with the holders of the founders' shares. The founders were determined to contest the right of the company to issue new capital. The chairman went on to remark that compromise was the only possible basis of settlement, and by consolidating all their interests they would be able to build up a reserve. The business of the company was never in a sounder position than at the present time, notwithstanding considerable reductions in the price which had taken place at the beginning of the present year, from 7½d. to 6d. per unit. The increase in the revenue for the quarter showed a most satisfactory increase over that of 1897. The returns that morning showed 63,000 lamps connected for the 12 months against 43,000 for the preceding period. There were 394,000 lamps connected, and applications for 13,000. In spite of competition, therefore, from local authorities, they had every reason to believe in the progress of the company.

After the solicitor had explained the exact position of the founders' shares, and sundry questions had been raised and answered, the following resolutions were put to the meeting and carried:—

"That it is expedient that the special rights and privileges of the 100 founders' shares in this company, whether with regard to dividend, capital, reserve fund or otherwise, should cease and be abolished upon the terms that each registered holder of a founders' share or founders' shares in the company should, upon having such share or shares converted into one ordinary share or shares, have the option of subscribing for 225 ordinary shares in the company at par in respect of each founders' share so held by him, and that the draft agreement for the purpose submitted to this meeting be and the same is hereby approved."

"And the directors of this company be, and they are hereby authorised to adopt the said agreement, and to affix the seal of this company thereto, with full power to assent to any modifications in the agreement which they think expedient in the interests of this company, either before or after the adoption thereof."

A vote of thanks to the chairman then concluded the proceedings.

Brazilian Submarine Telegraph Company, Limited.

The forty-ninth ordinary general meeting of the shareholders of the above company was held on Wednesday at Winchester House, Old Broad Street, Mr. J. Denison Pender presiding.

The Chairman, in proposing the adoption of the report, said the first thing that devolved upon him was to refer with regret to the death of a colleague. Since they last met they had lost Lord Sackville Cecil. His training as a young man enabled him to acquire a knowledge of electrical business which was of considerable value to the company, and his death was therefore a great loss to them. When one unfortunately fell out, it was, of course, the duty of the directors to find a successor, and he was glad to say that in the present instance they had been able to secure the services of Sir John Wolfe Barry, K.C.B., as a member of the board. Although Sir John Barry might not be known to them personally, those who had watched the great engineering feats that had been carried out of late years must know his name perfectly well. He thought, therefore,

they were to be congratulated upon having obtained the consent of Sir John Barry to act as a director. He would now draw their attention to a few points in the report. With regard to the accounts, the income for the half-year ending December 30th, 1897, amounted to £100,300; for the previous half-year it was £79,133, which showed an increase for the last half-year of £21,000. Of that increase £20,000 was due to increased message receipts and small sums of £62 and £250 respectively for interest and transfer fees, and dividends from other telegraph companies. The increase in the message receipts was satisfactory, and arose first from their having carried a larger amount of traffic than in the previous half-year—the increase being 97,000 words of ordinary commercial traffic and 18,000 words of press messages, which, as they knew, was carried at a considerably reduced rate. A considerable portion of that increased traffic was, he hoped, taken from competitive lines on account of the satisfactory working of their system. The second factor that had led to their increased receipts was the reduced loss on exchange upon the traffic receipts collected in Brazil, resulting from the provisions agreed upon at the International Conference in 1896, at which their company was represented. Those provisions which were now being carried out by the Brazilian telegraph department and by the telegraph companies, came into operation on July 1st last, and consequently its beneficial effect was apparent for the first time in the accounts which were now under review. Unfortunately, the fall in the gold value of the milreis had continued. Between July and December, 1897, it was fairly steady at an advance of about 7⅛, but in the current half-year it had fallen to a little less than 6d. It had of late, however, shown a rising tendency, which he hoped would continue to the advantage of the Brazilian Government and of themselves. If they compared the receipts of the past half-year with the corresponding period of 1896, they found an increase of £11,327—a much smaller sum than the £21,000 which he had just mentioned as the excess over the previous half-year. Turning to the expenditure side of the account, they found that the total expenditure for the half-year was £26,000 odd, and that for the previous six months was £20,500. That showed an increase of £5,661, which was fully accounted for by the fact that whilst in the June half of 1897 there was no expenditure upon repairs to cables, in the December half nearly £6,000 was spent under that head. He had before called their attention to the item of cable repairs, and asked them, in examining the accounts, not to take too much notice of any diminution under that head, because the experience was, that sooner or later heavy repairs had to be carried out. If they saved them in one year they came in another, and therefore, although they were to be congratulated on getting through a half-year without any heavy expenditure, if they took the average, that expense came out at a pretty considerable amount. So far, however, they had been exceptionally fortunate in that respect. There were increases and decreases of expense under a number of heads of which he would not trouble them with the particulars, but the net results were an increase of £36 in London and £234 at stations, together making £270, which he thought they would look upon as very satisfactory. Even against that small increase there was a decrease of £235 under certain heads, so that there was an actual decrease on the total. After payment of £3,200 for the debenture interest and sinking fund, and providing for the payments of income-tax, there was a credit balance on the half-year's business of £69,580, to which had to be added £7,221, the balance brought forward from June 30th, making together £76,801. The usual interim dividend for the September and December quarters, amounting together to £39,000, had been paid; £25,000 had been transferred to reserve, and £8,662 had been carried forward. Before arriving at that final figure there was deducted a special item of expenditure, quite apart from the ordinary expenses of the half-year. Last year, as they were all aware, the Diamond Jubilee of the Queen was celebrated, and to mark such an unique event many companies gave a bonus to their staff. The directors of the associated telegraph companies considered the matter, and decided to give a bonus to their staffs, and that was carried out on a principle jointly agreed upon all round. In their case the bonus also marked the twenty-fifth anniversary of the existence of the company, and he felt sure that every shareholder had reason to be satisfied with his investment, at whatever period of the company's existence he became interested in it. That consideration for their staff had been fully appreciated by those who served them at home and those who were abroad. He hoped they had still got with them many original shareholders, as he was pleased to say they had officers, who entered the service when the company was formed, and when submarine telegraphy was in a very different position to that which it held to-day as a public investment. They had had the defect in the No. 1 Lisbon cable mentioned to them at past meetings. That defect still existed, but as the cable was carrying the traffic in a satisfactory manner the directors had left well alone, and had not undertaken the removal of the fault, which, however, was in deep water, and which, when it did break down, would be a rather costly, and long business to put right again. He thought he had touched upon all the salient points, but it was rather hard to find anything new to say, seeing that they met half-year after half-year, and received their dividends and bonus regularly every three months. Not only were they receiving a really substantial return upon their investment, but funds were being put to reserve to insure their capital, and therefore there was very little more to be wished for. There was one paragraph in the report to which, perhaps, they would expect him to refer. The directors said:—"Negotiations for closer working with the Western and Brazilian Telegraph Company, Limited, have been in progress, and an agreement will shortly be submitted to you." He begged that the shareholders would not ask him to answer any questions on that subject, because the negotiations were not quite concluded at the present time, and when they were concluded they would all be called together to consider what he believed would be an agreement beneficial to the shareholders of that company and beneficial to the general public, and therefore certainly beneficial to the two countries by which those cables were connected.

Mr. F. J. Hamley said he noticed that £25,000 had been again added to the reserve fund, and he would like to know when the directors would consider that fund sufficiently large.

The Chairman said that, as a large shareholder, he would very much like to have an increased dividend, but the directors not only wanted to give a regular dividend every three months, but also to make the shares of the company one of the best securities going, and they could not do that without insuring their capital. That was the reason they were going on increasing the reserve fund.

Mr. F. Ycule seconded the motion for the adoption of the report, and it was carried.

A vote of thanks to the chairman and directors and the staff concluded the proceedings.

Harrow Electric Light and Power Company, Limited.

The report of this company presented to the general meeting on May 24th says, that during 1897, 1,540 8-C.P. lamps were added to the mains, making a total of 5,440 lamps with 87 customers. It had been necessary to practically double the size of the station and provide more plant. The station is now equal to a supply of 9,000 lamps, and further plant can easily be put in. In 1897 50,109 units were consumed. The balance to credit of revenue was £513. This has been devoted to interest on debentures, mortgages, and loans, writing off preliminary expenses, &c. New capital (£20,000) has been issued.

The Electric and General Investment Company, Limited.—Subject to the completion of the audit, the directors have decided to recommend to the shareholders the payment of a further dividend upon the capital paid up on the ordinary shares at the rate of 30 per cent. per annum for the six months ended May 31st last, together with a bonus of 10 per cent., making, with the interim dividend of 10 per cent. already paid, a total dividend of 35 per cent. for the year, and also to recommend a dividend of £50 on each founders' share for the year. The trustees for the founders' shares reserve fund propose to distribute to the holders of such shares a sum of £20 per share out of the proceeds of investments sold and dividends received in respect of the founders' reserve fund, making, with the before-mentioned dividend, a total distribution of £70 on each founders' share. The dividends, &c., to be payable on June 28th, 1898.

Callender's Cable and Construction Company.—The accounts for 1897 show a credit balance of £24,746. It is proposed to pay a dividend for the year of 10s. per share, with a bonus of 2s. 6d., being 12½ per cent. The sum of £3 000 is appropriated for depreciation of machinery and plant, and £5,196 is carried forward.

The transfer books and register of members of the above company are closed from 8th inst. until 16th inst. inclusive.

Stock Exchange Notices.—The Stock Exchange Committee have ordered to be quoted in the Official List:—Eastern Telegraph Company, Limited—Further issue of £129,653 4 per cent. mortgage debenture stock. The Stock Exchange Committee has appointed a special settling day as under:—Tuesday, June 28th: Cape Electric Tramways, Limited—114,843 additional vendors' £1 shares, fully paid, Nos. 285,158 to 400,000.

Royal Electric Company of Montreal.—Messrs. Coates, Son & Co., have been advised that the directors of this company have declared a dividend on the share capital for the quarter ended May 31st of 2 per cent., being at the rate of 8 per cent. per annum, and that the same will be payable on and after July 2nd.

Commercial Cable Company.—The directors have declared a quarterly dividend of 1½ per cent. on the capital stock, payable on July 1st.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending June 3rd, 1898, were £3,717 3s.; corresponding period, 1897, £2,461 14s. 7d.; increase, £1,255 8s. 5d.

The City and South London Railway Company.—The receipts for the week ending June 5th, 1898, were £949; week ending June 6th, 1897, £945; increase, £4; total receipts for half-year, 1898, £23,627; corresponding period, 1897, £23,335; increase, £292.

The Dover Corporation Electric Tramways.—The receipts for the week ending June 4th, 1898, were £184 10s. 10d.; total receipts to June 4th, 1898, £2,541 11s. 1d.

The Dublin Southern District (Electric) Tramways Company.—The receipts for week ending Friday, June 3rd, 1898, were £817 1s. 8d.; corresponding week last year, £578 6s.: increase, £238 15s. 8d.; passengers carried, 113,193; corresponding week last year, 87,882; aggregate to date, £10,315 4s. 10d.; aggregate to date last year, £10,627 17s. 7d.; decrease to date, £312 12s. 9d.; mileage open, 8 miles.

The Liverpool Overhead Railway Company.—The receipts for the week ending June 5th, 1898, amounted to £1,869: corresponding week last year, £1,324; increase, £545. 1898 includes Whit Monday, 1897 includes Whit Sunday.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending June 3rd, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,066.

THE TELEPHONE INQUIRY.

(*Continued from page* 722.)

The Select Committee of the House of Commons appointed to consider the desirability of giving greater facilities to municipalities in connection with telephonic development sat again on Tuesday last, under the chairmanship of Mr. Hanbury.

Mr. J. C. Lamb, C.B., second secretary at the Post Office, said that at the last sitting of the Committee they referred to the signing of the heads of agreement between the Post Office and the National Telephone Company in August, 1892. The full agreement was not signed till March, 1896. Two years were occupied in endeavouring to give effect to the policy of Her Majesty's late Government, and that involved laborious negotiations, which more than once threatened to break down. They had to find a solution of many difficulties. One was the question of the price to be paid for the trunk wires. The price was to be the sum shown by the company's books. Generally, the heads of the agreement said the price to be paid was to be the cost price, as shown by the company's books plus 10 per cent., but when they came to investigate the matter they found the cost price was not shown in the company's books, and therefore they had to come to an arrangement with them as to the method in which the value of the wires was to be ascertained. It was mutually agreed that two engineer experts should be appointed, one by the company, and one by the Post Office, to ascertain the estimated cost price. Another difficulty arose in connection with the areas, and it was only after long negotiation that any understanding could be arrived at; the company wished to work the trunk wires themselves, because they saw it would necessitate extra points of switching. When the Government would not agree to that, the company suggested that one end of the trunk wire should be worked from the company's exchange and the other end from a post office. That was also rejected, and then a plan had to be devised to reduce the difficulty of additional points of switching, and that took a very considerable time. Another question arose with regard to the number of wires to be erected between the exchanges of the company and the Post Office. They also had to come to an agreement with respect to poles. A great difficulty was that the company was not willing to enter into the question. They felt it was a thing they were urged by Government to enter into. They felt that in parting with the trunk wires they were parting with that part of their system which afforded very great protection against competition.

The Chairman: Did the full agreement of 1896 differ in any respect from the heads of the agreement?—It did not differ in principle.

Witness proceeded to deal with the question of the charges for the use of the trunk wires, which were those now in existence. At present they had no express messengers at the post offices to carry telephonic messages except in some parts of London.

The Chairman: The effect of the present arrangement is to play into the hands of the National Telephone Company?—No; it is not the law of the Medes and Persians. The present arrangement is simply arrived at as the result of a real consideration of what the public demands are.

Is it not a fact that under the present arrangement a telephonic message can only be sent to a subscriber of the National Telephone Company in Glasgow?—No.

To whom can it be sent?—It can be sent in the same way as it is frequently sent to Paris. That is, the correspondent at the other end attends the call office and receives the message.

But how does he know when to attend?—There are arrangements made for the regular attendance every morning of people who have business to do.

Are there the same arrangements in Glasgow?—I do not know; but it would be possible.

Mr. Cohen pointed out that that would not cover the point put forward by the chairman. How would a person not expecting a message know a message was being sent?

Witness said it was a usual thing for a telegram to be sent asking the person to attend at the call office.

The Chairman: Not a very business-like arrangement.

Witness said it was the custom. He considered there was no demand for the express messengers to carry telephonic messages. If there was a demand he would like to know where it was.

The Chairman: Do you see any difficulty in extending the system of telephonic communication by express messengers apart from the effect it would have on the telegraphic revenue?—I do not think there are any other difficulties.

Continuing, Witness said the trunk system had gone on extending since 1896. Thirty extensions had been carried out or were being carried out under guarantee by the company. The miles of wires purchased for the company were 29,000. The miles of wires constructed were 24,526. The mileage in course of construction at the present time was 4,647 miles. The mileage guaranteed was comparatively small. With regard to the areas of the company, the principles adopted in making them were as follows:—(1) Industrial areas of wide extent should be recognised in cases where there are any considerable towns forming centres of business. (2) That neighbouring towns intimately connected with one another in business relations should be included in the same areas; and (3) That small towns and villages in any one of which it would be hopeless to establish a local exchange system unless there was some cheap means of communication with each other, should be grouped together in one area. All urban districts were areas in themselves. Pretty well the whole of the country was divided into areas in which the National Telephone Company had the power to establish an exchange without further license. The company was under no obligation to start an exchange, but the Post Office could grant a license to any other body to start an exchange. Since the agreement was signed in 1896 in only one case had the monopoly of the telephone company been broken down, viz., in Guernsey. The charges there were low, but he did not know that they were lower than the company was prepared to supply the service at. Changes had been made in the areas from time to time, the tendency having been to rather increase the area. The largest area was the London area. Before the company was confined to areas, they had to a large extent arranged themselves in areas, and the London area was in existence. The area was not nearly so big as in some places abroad. There was no limit on the discretion of the Post Office as to laying trunk wires. The only effect a large area had was to reduce the use of short trunk wires. In a number of those areas they had Post Office exchanges competing with the National Telephone Company's exchanges. The principal exchange was at Newcastle-on-Tyne, where they had 626 subscribers. The number of subscribers to the National Telephone system in Newcastle-on-Tyne was much larger. The charges of the Post Office were: For business houses, £8 within half a mile of the exchange, £9 within three-quarters of a mile, and £10 within a mile. He believed the charge of the company was a uniform one of £10. Previous, however, to October of last year the Post Office charged £10 for half a mile, £12 for three-quarters of a mile, and £14 for a mile. The Post Office charges were based on what was supposed to bring in a profit to the tax payer. They were not allowed to canvass, and were not allowed to give preference to firms. The company gave preference, but he did not consider it was the business of the Post Office to complain. He could not say to what extent the preferences had been given by the company. The reduction in the price at Newcastle was bringing them an increase in the number of subscribers. They had offered to put their subscribers at Newcastle in communication with the subscribers of the company, but the company were not willing that that should be done. The Post Office had no legal power to insist upon such a connection.

Questioned by Mr. Stuart, Witness said it would not be possible for the Post Office to lay a trunk line of a few yards in Newcastle and so join their system to the National Telephone system. A trunk line was defined as a line used to connect one area with another.

The Chairman: Do you know any towns where there is competition in which the price charged is lower than where there is no competition?—I do not think that is so.

You do not think competition has had any effect upon their prices?—I cannot tell what effect it has, but as a matter of fact the company's charges are higher in Newcastle than in other towns, probably because they are smaller towns.

Mr. Cohen: Is it not a fact that their prices are based on your charges?—I think that is so.

The Chairman: You have been in unequal competition owing to higher rates?—Yes.

Without disclosing secrets could you tell the committee whether you have made any loss?—No.

And we may say you have made a fair profit?—Yes.

Although there are two competing systems?—Yes.

Are the charges of the company higher in Cardiff and Swansea?—For certain distances I think they are.

Questioned by Mr. Bartley, Witness said the company considered it their duty to fall in with the policy of the Government when the heads of agreement were drawn up, and he did not wish the impression to go forth that they purposely put difficulties in the way.

As regards sending Post Office messengers in London and not in other parts of the country, who authorised that arrangement?—The idea was to give a local service, and it was set forth in a Treasury minute. The whole service was contemplated as a local service, and the question of doing it between one town and another was not in the minds of those who did it.

How does it differ from sending from one town to another?—The impression I suppose was that the telegraph was sufficient to meet that.

Mr. Cawley: Is it in the interest of the public that the National Telephone Company should not have the competition of the Post Office?—I find it very difficult to answer that question. My opinion is that it is very undesirable for a private company to have a monopoly. On the other hand, I am firmly convinced that the establishment in one town of competing systems of telephones would not be in the interests of the public. My opinion is that the whole thing should be in the hands of the Post Office.

Sir J. Woodhouse: You agree there is no obligation imposed by the Post Office, either in the original license or by any agreement with the Telephone Company that they should supply the company with the facilities for which they are licensed?—Yes.

Therefore in two respects; first, no obligation to supply, and secondly, no restriction as to the charges to be made, it does not differ from any other monopoly granted?—The whole arrangement differs.

But don't you agree that it has been very much to the disadvantage of the public?—I think it has been.

Did I understand you to say with regard to the agreement of 1892, that Sir James Ferguson took one line of action, and the Government another?—No.

Do you mean that the Department would have taken one action and Sir James Ferguson another?—No. What I mean is that Sir James Ferguson was requested by the Government to carry out a certain line of policy, and he did so.

What was the difference?—The policy of the Department was to purchase the whole of the National Telephone Company's undertaking.

And the policy of the Government was to take only the trunk system?—Yes.

And the tendency of the policy of the Government was to discourage competition?—That was the tendency.

Further examined by Sir J. Woodhouse, Witness said there was

no effective competition between the New Company and the National, for the New Company had no exchange. The competition in Manchester was a very feeble competition. The tendency of the policy of the Post Office since 1892 had been towards making the National Telephone Company a monopoly, but at the same time all the rights of the Postmaster-General had been fully preserved. The heads of the 1892 agreement were brought before the House of Commons in 1894 when it was laid on the table. The Treasury Minute lay in the House in May, 1892, and the Bill to raise the money for the purchase came before the House on May 26th, 1892. The agreement was signed August 11th, 1892, and the Postmaster-General went out of office on August 19th. The agreement was signed the day the vote of censure on the Government came in.

By Mr. COLVILLE: Some of their subscribers in Newcastle had been obliged to become subscribers also to the National Telephone Company.

By Mr. BOSCAWEN: General application had been made by local authorities and other companies for licenses to start telephonic services in different towns, and they were ready to comply with the terms of the Treasury minute. The Postmaster-General had been in consultation with the Chancellor of the Exchequer on the subject, and they had not seen their way to granting those licenses. He thought they had considered each case and had arrived at the conclusion that they were not justified in granting the request. They had received applications from the Corporations of Glasgow and Tunbridge Wells and Manchester, and in Glasgow it was admitted that the service was defective.

Mr. BOSCAWEN: Yet in no case has a license been granted?—No.

Consequently, the condition in the minute is practically a dead letter?—The right is there still.

Is the right of any use if it is not carried into effect?—I think it is.

Is it the intention of the Post Office in the case of future applications to refuse as the previous ones have been?—I think that is a question that the chairman could answer better.

Have you any different line of policy in the Post Office?—I must decline to answer that, unless the chairman instructs me.

Have not the Telephone Company taken the cream of the country?—They began in that way, but they are extending their service.

Proceeding, WITNESS said he would not allow municipal bodies to establish telephonic systems in places where there was no service, but would leave it to the Post Office. The Post Office had not established many services of late years, because there was no demand for them. From their own point of view, the company had pursued the wise policy of getting the leading men of different places to work with them. He did not know the means employed, but it was the outcome of a bad system. From a commercial point of view, it was not an unreasonable system for the company to adopt. His remedy would be to take over the whole system, and put it in the hands of the Post Office.

By Sir H. HOWORTH: When the legal proceedings against the Telephone Company were going on the Post Office submitted proposals to the Treasury for establishing telephones, and in a letter dated December 16th, 1880, the Treasury consented on the understanding that it would enable the Department to negotiate satisfactorily with the telephone companies. He believed that great inconvenience to the public would arise if they had competitive systems in different places. It would probably take eight or nine years for the Post Office to establish a really proper competitive system over the country. In Sweden the State had bought up all the local districts, with the exception of one. In France there was no private company, and in Italy there never had been a private system. The only place where there was a municipal service was Holland, and in that country the trunk lines were in the hands of the Government. Some facilities had been given by the Government to the Telephone Company outside the agreement.

NEW HAVEN STREET LIGHTING.

THE average reports of city lighting committees are not absorbingly interesting documents, but once in a while we (New York *Electrical Engineer*) come across one that gives us some real information. An example of such is the 1897 report of the Committee on Lamps of the city of New Haven, Conn., just issued. As the lighting of this city is in most intelligent hands a closer inspection of this report will prove of value to lighting committees and central stations as well. New Haven is lighted by three systems, gas, naphtha, and electric; there being 442 arc lights, 105 Welsbach, 633 plain gas and 512 naphtha lamps. All lighting is done by contract with private companies. The city is now paying $98·55 per arc light of 1,200 C.P., the electric lights being lighted at dusk and extinguished at dawn every night in the year, thus covering 4,000 hours of burning. Regarding the question of complaints due to outages, &c., we notice that from these various causes gas gave rise to 1,168 complaints, naphtha 709, electric lights 401. Quite a marked percentage of these complaints were due to the effect of a high wind last November, in which, however, the electric light showed up remarkably well. While none of these were out or broken, the Welsbachs showed one out, plain gas showed eight out and one broken, while naphtha showed 77 out, for that one night. During the whole year 278 lamps were reported out at various times, of which 50 occurred in a single night during February, 1897, when one of the circuits was broken by a falling tree during an extraordinarily high wind. Considering that the total number of electric lamps is 442 burning every night, and that only 278 lamps were reported out during the entire year, the record is a very good one. That the service must have been excellent is strongly evidenced by the fact that the entire amount deducted during 1897 from the bills of the electric light contractors was only $21·33.

In his very able comments on the figures presented, Mr. Henry Hopkins, Superintendent of Street Lighting of New Haven, states that the service rendered by the electric lighting contractors has been of a high grade. Mr. Hopkins also has something to say on municipal ownership of electric lighting plants, and as we believe his motives will not be questioned by any one who has followed his career, his opinion is worth recording. Mr. Hopkins says:—"From what data and facts I have been able to obtain on both sides of the subject, I would say, that until the time comes when more information and accurate facts can be obtained, it would not be good business policy to enter into any such project. The recent showing up of the Philadelphia Municipal Gas Works amply sustains my belief, and ardent supporters of municipal ownership must have received a severe shock. And it is only one of many cases that could be quoted." Coming from a city official, this is a most encouraging sign that there are still many clearheaded men in municipal employ in America.

Electric Power for Mines Drainage.—A second scheme for unwatering the Tipton mines was enunciated before the South Staffordshire Mines Drainage Commissioners on Wednesday last week. It was explained that the first scheme had gone as far as it would at present. The drainage of the level had not quite had the anticipated effect. They expected it would fetch out at least 3,000,000 gallons, whereas it had only brought a third of that amount. The question they had to decide therefore was what was to be done in regard to the unwatering of the mines, seeing that they could not expect by any reasonable amount of levelling to attain the end they desired — in fact, the cost of driving levels into every proprietor's colliery would be larger than could be met by the funds the Commissioners had at their command. It was, however, absolutely necessary that they should deal with the water in some way or other. The original Tipton district engineering scheme was to have two large pumping engines at different stations, and an extensive hydraulic system whereby they could pump from various points in the district which were not reached by the main engines. Since the scheme was propounded, the Midland Electric Corporation for Power Distribution, Limited, had tried to establish themselves in the district, and if they succeeded, as they believed they would, the Commission, instead of having to find a large capital for an hydraulic system, besides the heavy cost of maintenance, would get a supply of electrical power at so much per unit, whilst the capital outlay would be considerably less. It appeared most desirable, if the Electric Power Company came into the district, that they should take advantage of their scheme, in order to drain the surface at points where at present water got into the mines because they were lower than the brooks, and at which no amount of levelling would be thoroughly effective. Their general manager (Mr. E. Howl) and surface works engineer (Mr. E. B. Marten) had gone carefully into the question, and found that there were at the present time about 50 points in the district below any drainage, where reservoirs could be made and pumps started driven by electrical power. By having these stations and electrically-driven pumps to deal with excessive rainfalls quickly, it was believed that the quantity of water now getting into the mines would be reduced by about one-third, which would be a great saving. They were now pumping, roughly, about 9,000,000 gallons every 24 hours, and if the suggested scheme could be carried out this quantity would be reduced to about 6,000,000 gallons, which their present engines could cope with. Then it was proposed to deal with that water which found its way into the mines, but would not flow to the main engines, by a system of semi-portable engines taken, by arrangement with proprietors, to collieries where they were most required. Probably eight or ten such pumping stations would drain the whole district, and enable mines to be worked that were now under water. The Commission had obtained authority to spend £100,000 on the Tipton district engineering scheme, but up to the present they had not spent much of this amount. It was calculated that the capital sum required to provide the 50 pumping stations would be about £20,000, in addition to which there would be the price to be paid to the company for the supply of the electrical energy and the cost of looking after the various stations. The sooner, the chairman added, the Electric Company came forward and helped the Commission out of their difficulty the better. The company had offered the Commission terms which were satisfactory, and he sincerely trusted that they would be able to carry out their proposals.

Electric Launches.—We understand that the British Electric Traction Company have undertaken the control of the Immisch Electric Launch Company, and that launches can now be booked at Donington House, Norfolk Street, Strand. The Immisch Launch Company, who were the pioneers of the electric launch business, now possess a fleet of over 20 launches, which are acknowledged to be the finest on the river Thames. An interesting descriptive and illustrated pamphlet, giving full particulars as to rates, and much useful information to frequenters of the river, can be had on application. The headquarters of the company are still at Platt's Eyot, Hampton.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, June 1st.	Closing Quotation, June 8th.	Business done during week ended June 8th, 1898. Highest.	Lowest.
137,400*l*	African Direct Telegraph, 4 % Deb.	100	4 %	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	7 — 8	7 — 8	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	93 — 96	93 — 96	...	...
923,960*l*	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	64 — 67	64 — 67	65½	64½
3,038,020*l*	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	115 —116	115 —116	116	115⅝
3,038,020*l*	Do. do. Deferred...	Stock	...	...	...	15¾— 16¼	15¾— 16¼	16¼	15⅝
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15½— 16	15½— 16	15⅝	15½
75,000*l*	Do. do. 5 % Debs. 2nd series, 1906 ...	100	5 %	...	...	112 —116	112 —116	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2¾— 3¼	2¾— 3¼	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297*l*	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	105 —107	106½	105¾
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	2 %	...	3/16— 5/16	3/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	6½— 7½	6½— 7½	7	6½
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	14½— 15½	14½— 15½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000*l*	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	4½ %	103 —106%	103 —106%	...	...
60,710*l*	Direct United States Cable	20	2¼ %	2½ %	...	10½— 11	10½— 11	10¾	10 9/16
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100—103	100—103	102½	102¼
400,000	Eastern Telegraph, Nos. 1 to 400,000	10	6½ %	6½ %	...	17 — 17½	17 — 17½	17⅜	17
70,000	Do. 6 % Cum. Pref.	10	6	6 %	...	18 — 19	18 — 19	18½	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,302,615*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	124 —128	124 —128	126	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	17½— 18	17½— 18	17⅞	17⅝
25,200*l*	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	100 —104	100 —104	...	...
100,500*l*	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	126 —129	126 —129	...	...
35,100*l*	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	100 —104	103¾	...
46,500*l*	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	...	...
300,000*l*	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	101 —104	101 —104	102	...
200,000*l*	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	105 —108	105 —108%	...	...
180,227	Globe Telegraph and Trust	10	4⅛ %	4½ %	4½ %	11¼— 11⅜	11½— 12	11⅞	11 9/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16½— 17	16¾— 17¼	...	...
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	10 %	28½— 29½	29 — 30	29 5/16	29
160,000*l*	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	5 %	100 —103	100 —103	102¾	...
97,000	Halifax and Bermuda Cable, 4½ % 1st. Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	98 —103	98 —103	101¾	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	50 — 53	50 — 53	...	...
100,000*l*	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	108 —111	108 —111	...	...
28,000	Montevideo Telephone, 6 % Pref., Nos. 1 to 28,000 ...	5	4 %	4 %	4 %	2¼— 2¾	2¼— 2¾	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	5½ %	6 %	5½— 5¾	5½— 5¾	5¾	5⅝
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 16	14 — 16	14⅜	14⅛
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5½	...
1,329,471*l*	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	101—106	101—106	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅜— ⅝	⅜— ⅝	...	...
100,000*l*	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	4 %	105 —108	105 —108	104½	...
11,839	Reuter's	8	5 %	5 %	5 %	8 — 9 xd	8 — 9	8⅛	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	...	...
58,000	United River Plate Telephone	5	4 %	5 %	...	4 — 4½	4 — 4½	...	...
146,733*l*	Do. do. 5 % Debs.	Stock	5 %	...	...	104 —107	104 —107	...	...
15,609	West African Telegraph, 7,501 to 23,109	10	4 %	*nil*	*nil*	3½— 4½	3½— 4½	...	...
213,400*l*	Do. do. 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	...	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3¼ %	12 — 12½	12 — 12½	12¼	12 1/16
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	7½— 8	7½— 8	7⅝	...
33,129	Do. do. do. Def. Ord.	7½	1 %	*nil*	½ %	4 — 4½	4¼— 4¾	4 7/16	4⅜
389,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	⅞ %	1 %	¾ %	½— ¾	½— ¾	⅝	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6 %	7¼— 7⅝	7¼— 7⅝	7 1/16	7 1/16
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	6 %	5 — 7	5 — 7	...	...
80,000*l*	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	106 —109	106 —109	...	...
1,163,000$	Western Union of U.S. Telegraph, 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	103 —108	105 —109	...	...
160,100*l*	Do. do. do. 6 % Ster. Bonds ...	100	6 %	6 %	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	12 — 13	12 — 13	12½	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
26,000	*Chelsea Electricity Supply, Ord., Nos. 1 to 10,277... ...	5	5 %	5 %	6 %	8½— 9½	8½— 9½	8⅝	8½
60,000	Do. do. do. 4½ % Deb. Stock Red....	Stock	4½ %	4½ %	4½ %	115 —117	115 —117	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	5 %	7 %	10 %	24½— 25½	24½— 25½	25¼	24¾
10,000	Do. Prov. Certs. Nos. 90,001 to 100,000 £5 ...	10	...	...	...	16½— 17½	16½— 17½	16⅞	16½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½— 17½	16½— 17½	16⅞	16⅝
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	129 —134	129 — 134	...	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	*nil*	*nil*	*nil*	13 — 14	13 — 14	13⅜	13⅜
10,000	Do. do. do. Nos. 30,001 to 40,000 £4 paid.	10	...	...	...	6½— 7½	6½— 7½	6¾	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	15 — 16	15 — 16	15¼	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400 £4 paid	5	...	...	...	3½— 4½	3½— 4½	...	...
10,000	House-to-House Electric Light Supply, Ord., 101 to 10,100	5	...	...	4 %	9 — 10	9 — 10	...	...
10,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	7 %	11 — 12	10½— 11½	10⅝	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	16 — 17	15 — 16	16⅜	15 5/16
220,000*l*	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	4½ %	117 —121	117 —121	...	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	18½— 19½	18 — 19	19	...
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7½ %	10½ %	14½ %	16 — 17	16 — 17	16⅝	16½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	9½— 10½	...	...
50,000	Do. do. 4 % Deb. Stock Red. ...	Stock	...	...	4 %	107 —110	107 —110	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2 — 2½	2 — 2½	2 7/16	2 5/16
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	16 — 17	15½— 16½	16⅛	15⅜

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation June 1st.	Closing Quotation June 8th.	Business done during week ended June 8th, 1898. Highest	Lowest.
30,000	British Electric Traction	10	...	...	...	15½ — 16	15½ — 16	15½	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 £4 pd. (issued at £2 10s. prem. all pd.)	10	...	...	...	7 — 8	7 — 8	7⅝	7½
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½ %	*nil*	*nil*	1⅜ — 2	1¾ — 2⅛	1¾	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2¼ — 2½	2¼ — 2½	2 11/16	2¼
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
19,894	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10½	10¼
129,179	Do. do. do. £6 paid	10	...	...	...	6 — 6½	6 — 6½	6¼	...
59,254	Do. do. Pref. half-shares £1 paid ...		...	...	...	1¼ — 1⅜	1¼ — 1⅜	1 9/16	...
67,680	Do. do. Def. do. £5 paid ...		...	...	...	4¼ — 4¾	4¼ — 4¾	4⅝	...
630,000*l*	City and South London Railway	Stock	1 3/16 %	1 9/16 %	1⅝ %	68 — 71	68 — 71	70⅝	69½
82,850	Crompton & Co., 5 % 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	... ...	88 — 93	91¾	...
99,261	Edison & Swan United Elec. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5½ %	...	2¼ — 2¾	2¼ — 2¾	2½	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5½ %	...	4 — 5	4 — 5	4 5/16	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	103 —105	103 —105	...	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	...	2⅝ — 2¾	2⅝ — 2¾	2⅝	...
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	...	3⅛ — 3⅜	3⅛ — 3⅜	...	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	106 —108	106 —108	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	½ — ¾	½ — ¾	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	½ — ¾	½ — ¾	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½ %	7 %	7 %	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	12 %	10 %	21½ — 22⅝	21½ — 22⅝	22¼	22
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	4½ %	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	22	21⅝
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	2⅞ %	3¼ %	10⅝ — 10¾	10 7/16 — 10 9/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15¾ — 16¼	15¾ — 16¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	34 — 37	34 — 37	...	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	103	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	132 —135	130 —133	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.

House-to-House, 4½% Debentures of £100, 107—110.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 15—16; 1st Preference Cumulative 6%, £5 (fully paid), 8—8½. Debentures, 107—110. Dividend, 1897, on Ordinary Shares 10%.

London Electric Supply Corporation, £5 Ordinary, 3½—4.

*T. Parker, £10 (fully paid), 15¼.

Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (June 2nd, 1898).

THE MUNICIPAL ELECTRICAL ASSOCIATION, 1898.

SWITCHBOARD APPARATUS.*

By J. R. BLAIKIE, Chief Assistant Electrical Engineer, Bristol.

THE control and measurement of electric energy is one of the most fascinating details of this branch of engineering.

The switchboard, with its glittering array of polished metal and graduated dials, has always an attraction for the lay mind, while its intricacy or beautiful simplicity is a source of wonder or poetic appreciation to those better acquainted with such devices.

Almost every station has some noticeable peculiarity with regard to its switch gear, and there are few stations that have not lived to see radical changes brought about in this portion of the original scheme. The result at the present time is that it is almost impossible to classify the types now in use. This striking nonconformity, although intensely interesting, is not particularly happy, since it appears to show either ignorance or vanity on the part of the designers.

One must admit that the spirit of commercial industry is to suppress varieties in favour of a standard. It would be ridiculous to suppose that the mere straining after novelties has been the whole cause of the present multifarious assortment. Switchboards have been conscientiously designed and constructed to suit individual cases, simply because there was no general standard that might be adopted. After certain results and experiments, modifications and improvements have been gradually introduced. But this form of private research work is too frequently misguided and uneconomical. The experimenter cannot, as a rule, afford to test a portion of his work to destruction. So long as it answers his immediate purpose he is satisfied.

A certain elegance of variety and some treasures of ingenuity must be sacrificed to further the march of scientific progress. One must be content to labour in a vast organisation and strive towards a higher ideal than a more or less original switchboard. It is hard for a young enthusiast to surrender an opportunity for displaying a capacity for design in a field of such unlimited possibilities. It is far easier for him to imagine that there are peculiar necessities and requirements in the case under consideration; but seeing that there are life risks, and that the very heart of the undertaking lies in the switchboard, surely it should be the outcome of the strongest possible combination of experience, and beyond the reach of individual fancy.

Before dealing with the disposition of the component parts of the switch gear, it might be well to inquire into the duties and characteristics of the details.

The necessity for ever breaking a circuit while carrying much energy is not universally granted. For example, Prof. Forbes, in his paper on "The Electrical Transmission of Power from Niagara Falls," November 9th, 1893, says: "I hold that it is a piece of culpable ignorance, ruinous to the machinery, if anyone should ever, on a large power circuit with alternating current, suddenly break the circuit while current is passing. The practice is quite unnecessary, and has given rise to a large proportion of the breakdowns of alternating current machinery." Nevertheless, there are switches at Niagara (see *Cassier's Magazine*, page 291, Niagara number) capable of breaking 5,000 horse-power, without damage to themselves, &c. Prof. Fleming agrees with Prof. Forbes, but he asks what happens if the circuit opens itself, and what is to be done about fuses. Unfortunately Prof. Forbes omits these points in his reply.

In practice, of course, one never opens a circuit conveying much energy, unless some unforeseen circumstance throws the whole or a portion of the machinery out of the usual control. Could not such emergencies be met by inserting a moderate amount of resistance or impedance in the circuit, increasing either by degrees, if necessary? The same might apply to cut-outs when they are under the observation of an attendant. In the author's opinion main switches should work through steps in this manner, making it impossible to make or break with large currents.

Assuming, as is customary, however, that a sudden break is necessary, or that the switch is in such form that a sudden break could be made by a mistake, or accident, on the part of the attendant, while transmitting a large amount of energy, the essential characteristics of the design appear to be as follows:—

1. That there shall be no danger to the operator, either by electric shock or from particles of molten metal flying free, this latter to apply to adjacent apparatus as well.

2. That there shall be no maintained arc.

3. That the contacts shall not be burnt or injured, in such a manner, as to prevent the efficient working of the switch on closing again.

* Read June 8th.

4. That the contacts and current carrying portions of the switch shall always be in such a condition that no heating will occur while carrying the maximum current for an indefinite period.

With reference to the first condition there are several well known satisfactory examples. The plug form having a large insulating handle and shield, the breaks being in earthenware pots, gives a pretty certain immunity from danger. A sufficiently long handle or mechanism actuated by cords can be considered safe.

Another method is to mount a plate glass screen between the operator and the breaking contacts, but this does not protect the other apparatus.

To secure a certainty of break many contrivances have been devised. The simplest means is a sufficiently long air-gap in the circuit.

For the sake of eliciting the opinions of the gentlemen assembled, some breaks (total length) for various conditions are suggested, assuming that the breaks are made with considerable and uniform rapidity.

Amperes	100 to 800 volts alternating or continuous.	500 to 1,000 volts continuous.	2,000 volts alternating.
	Inches.	Inches.	Inches.
5	$\frac{3}{4}$	4	4
25	1	6	6
50	$1\frac{1}{4}$	8	10
75	$1\frac{3}{4}$	10	12
100	2	12	13
150	3	$12\frac{1}{2}$	14
200	4	13	15
300	5	14	16
400	6	15	18
500	7	16	20

(When these breaks are in the tubes, and so protected from air currents, it might be well to add, say, 50 per cent. to the length of the gap, and the same if the breaks are in a vertical direction.)

The air-gap may be in one line, but in order to save space and ensure a rapid break, it is more frequent to have several breaks made simultaneously in a circuit. It is not safe, however, to draw out two or more arcs, close together in air, without a substantial fireproof insulator between, as a slight current of air will blow them together, and thus defeat the action of the switch.

The plug switch becomes rather too cumbrous in large sizes since the sockets must be very deep or the plugs must be spaced out considerably.

One very happy solution is the use of an electro-magnet in the main circuit to blow out the arc when it is formed. Another effective, though perhaps rather complicated means, is the application of a shutter, or clapper, which flies through the path of the arc and blows it out with the air currents set up. Some other designs cause the circuit to be broken under water or an insulating oil, but to the author this appears to be a last extremity, as there are obvious objections to the use of a liquid.

To satisfy the 3rd condition "that the contacts shall not be burnt, &c.," is a comparatively simple matter. The rate of breaking is a primary consideration, though it may not apply so forcibly in the case of the alternating currents. The use of springs, or the multiplicity of simultaneous breaks, suggests itself at once. A liberal weight of metal, or the proximity of a good heat conducting fireproof insulator, reduces the temperature of the arcing points somewhat. As an extra precaution, the blades are usually made of wedge shape, and plugs are tapered, so that they may clear themselves more or less on returning, by shearing off the small globules of metal left on the contact faces. It is therefore desirable that the mechanism should be able to withstand such strains, and so proportional that sufficient force can be applied. Another way of overcoming this difficulty is to provide auxiliary contacts which break just after the main contacts, and so carry the arc. These contacts may be merely butting surfaces, which are not much the worse for being burnt, or provided with easily renewable faces, or some material having a high melting or volatilising point; such as carbon.

The degree, in which the various switches on the market meet this requirement, is readily seen.

The current-carrying capacity of the contacts is of the greatest importance, since a defective contact deteriorates at a sort of compound interest law. Taper plugs and spring jaws almost invariably share this responsibility. When one reflects that trouble from this source may loosen the whole contact from the board by destroying an ebonite bush, melt the solder from a sweating thimble, and allow a cable to fall, or even render the handle of the switch useless or unsafe, there is enough material for serious thought. In addition to this, there is not a very far remote chance of fire. Possibly there may have been few accidents up to the present time from this cause, owing to the newness of the apparatus, or from the fact that many switches are not working up to their full capacity. Certainly in point of design this is one of the weakest features. In some instances, the spring in cast brass and copper, without any means of adjustment for wear, is all that can be relied upon. In the case of four plugs rigidly fixed to a handle there are instances where they are supposed to go tight home into four *fixed* conical sockets. There are a few relics of the dark ages, when current was allowed to pass through the hinge or pivot of a switch. Of course there are contacts of the laminated type, built up of hard drawn or hammered copper, which are admirably suited to their purpose. As a general conclusion, under this heading, it appears that it is advantageous to have few, preferably only one breaking contact in a circuit, which can easily be arranged by means of flexible connections. This arrangement gives the operator an opportunity of feeling the condition of the spring contact while forcing the switch home.

It has occurred to the author with reference to this subject, that there might be a useful application of a well-known invention of a paint which changes colour on heating.

The merits and risks of automatic apparatus open a very wide question. Where springs are employed, they should only be strained through a small part of their range, and carefully secured from all possible chances of getting heated, either by current passing through them, or by conduction or radiation from other sources. There should also be some provision for retaining the spring, or parts of it, should it happen to break. A single speck of rust on a steel spring will sometimes cause it to break; but the reliability of such springs as are used in watches and rifle locks may be urged in favour of their use when thoughtfully applied. Weights released by triggers and catches are frequently used with success, but the inertia may sometimes be a drawback. Special attention should be paid to hinges, &c., in such apparatus, since a slight defect may alter the adjustment, or foul the whole mechanism. In switch work it is quite common to have brass working on brass, both of the same composition; this is sure to cut and bind in time. When it comes to talking of an automatic appliance that does not work, adjectives fail. Another point sometimes neglected is the provision of suitable buffers, or arrangements for taking up the mechanical shock or jar. Unfortunately nearly all insulating materials are mechanically weak, so they should never be subjected to rough usage. In most cases these switches are set by hand, and can therefore have strong reliable contacts. Where they have to be operated at a distance by means of a small current, the contacts are a serious trouble. An accumulation of small impulses can be used, or the much-abused mercury cups have to do duty. There are details in mercury cups, however, which make all the difference. The cups should be of iron nickel-plated, the copper forks should also be nickel-plated, and be shaped to cause as little splashing as possible.

For large currents and high voltages a multiplicity of breaks should be employed, so that a comparatively low speed will be sufficient. The author has had under his notice a switch for 15 amperes, 100 volts, in daily use for about three years. Three others, one for 15 amperes, 200 volts, the other two from 8 to 15 amperes, 100 volts, for 18 months. All these switches have given complete satisfaction, and up to the present time have required absolutely no attention.

Switches requiring a shunt coil permanently in circuit are generally looked at askance, not for the sake of the coal here represented (though one does sometimes hear about the fuel consumed by a voltmeter) but mainly because the shunt coil has been known to break down.

If it were recognised that a coil will not stand unlimited cooking at, say, 150° F., that it is subjected to high pressure strains, due to induction at times, and that in the case of alternating currents, the wires must be specially supported and secured to resist the tendency to vibrate, then perhaps a coil could be made worthy of the occasion. What may be good enough for a single arc lamp is not good enough to bear the reputation of a cental station.

So much for main switches. Plug connections have some points in common, though the problem is very much simpler. A taper plug between two blocks of metal, although almost universal for laboratory instruments, is rarely, if ever, used on a switchboard. A spring clip made to sandwich two projecting tongues is sometimes used, but the most usual form is a screw plug to connect bars on the back and front of a slate panel. Another form connects a back and front board by pushing a parallel plug through spring contacts. Ample weight of metal will, in most cases, make a sound connection, since there is nothing to impair the original fit.

For very heavy currents, perhaps, in the case of screw plugs, it may be well to have a spanner appliance instead of the ordinary fluted handle. The fire risks should also be considered, in the event of a plug being taken out by accident while carrying a current. Facilities for replacing a portion of the bars damaged in this way would be advantageous.

Fuses, although so simple in conception, are often one of the most troublesome details. For low tension circuits certainly the problem seems elementary, yet there are cases where links of copper as large as the mains have been substituted for fusible metal.

There is a difference of opinion as to the most suitable metal for a fuse. Tin, lead, and copper are generally employed. Then comes the question as to whether a thin strip, a single wire, a number of single wires stretched parallel to each other, or a number of small wires twisted together, makes the most reliable fuse.

The purity of the metal is also of great consequence. In designing a fuse, the objects in view are:—

1. Safety to attendants and adjacent instruments from molten metal or splintered insulating material.
2. A positive break in the circuit when the fuse does melt.
3. An accurate knowledge of the capacity under the condition of its mounting.
4. Durability.
5. A safe, simple, and rapid means of replacing.
6. Mechanical strength, rendering it independent of skilled or specially careful handling.
7. Protection from other sources of heat from imperfect contacts, &c.
8. Compactness.

Taking a few common examples, they are mostly defective in one or two points.

The tin strip reduced in section at the centre is generally suitable for low tension work, but it is almost invariably unprotected, and frequently in such a position that it will blow right in an attendant's face if he should happen to close a switch on a "short circuit."

This type is the most durable, and the most accurately gauged, but if a large range of sizes is required it is a nuisance to have to keep so many spares, especially as they are usually of a particular pattern. A rapid replacement is managed by throwing over a link or inserting a plug to connect another fuse already mounted. Otherwise it is satisfactory.

For high tension work, there are quite a lot of examples that will not break the circuit in the case of a sudden "short circuit." Copper wire is generally most successful, since there is a less quantity of vaporised metal left in the path of the arc. In very small sizes, however, it is difficult to manipulate. Running in its normal condition, at a high temperature it deteriorates rapidly. Again, with a variety of fittings and mountings, the value for any particular gauge alters considerably. Where the balance is held in favour of copper, there should always be an easy means of inspection at any time. Either a transparent shield should be used or a duplicate system employed, which will allow a fuse to be removed and examined without interrupting the supply. One well-known fuse consists of a length of wire soldered at either end to plugs having ebonite handles. The mechanical weakness of this arrangement may lead to serious accident. The operator gets one plug in, then, perhaps, breaks the wire, and the live end sags down and touches his hand. Besides this, there is the inconvenience of having to solder the wire to the plugs. Another has a wire fitted into a gauge glass, sealed at the ends, and half full of a liquid. These have been known to explode with great violence. Let us hope that they have long since joined the ranks of "our old type."

A lead wire encased in an India-rubber tube, or a copper wire in an asbestos sheath, have been used with success as far as the break goes; a wire in a glass or earthenware tube, with the ends open, is reliable if of sufficient length. One of the most recent designs has many novel features. The holder is in the form of a drawer made of earthenware, having a partition down the middle lengthwise. The fuse is a short length of wire, strained over the partition by means of two springs, the current being conveyed through flexible conductors from two wedged contact pieces projecting from the back end of the drawer. When in use, the drawer is filled with a special oil and pushed home, so that the wedges enter spring jaws. When the fuse wire melts, the springs carry the ends down under the oil, and so extinguish the arc. The makers claim that with this fuse 500 amperes at 2,000 volts can be broken without any hitch.

The percentage of error in adjustment must be rather large, since it would take some time to warm up a large mass of earthenware and oil, and again, the unknown tension of the spring introduces another source of error. The fuses are arranged in duplicate for inspection and rapid replacement and are extremely compact.

Ammeters.

Ammeters for the switchboard should be altogether different from laboratory instruments. The scale should be more accurately readable at the lowest part, if there is any difference. On a rising load, one cannot run too close to the capacity of a machine, while it is of the highest importance that one should know when the load has fallen sufficiently when switching out a machine. Again, when used on circuits, for perhaps 20 hours out of the 24, they are only indicating on the lower part of the scale. In practice they are often subjected to powerful external influences, since it is generally convenient to fix them close to the main omnibus bars. They should, therefore, be specially protected from such disturbances. The moving parts should be strong enough to stand excessive currents passing momentarily, and for many cases the movement should be damped.

An ideal instrument, if not quite dead-beat, might have a damping arrangement adjustable, so that the necessary amount could be applied under peculiar circumstances. An arrangement of terminals such that a standard instrument could be connected in series by means of flexible leads to enable the instrument to be checked while in position would be very convenient. Where a glass cover is used, it should be far enough away from the pointer to minimise errors due to static charges on the surface.

The Edgewise pattern is becoming popular now for two reasons; it is more compact as a switchboard fitting, and when fixed in rows, and the index of each standing at a different value, you get a curve formed. The shape of this curve becomes more or less familiar to the attendant, so that he more readily notices a change which may point to an irregularity in the outside system. Ammeters for the exciting circuits of the machines are usually only required for alternators. To make intelligent use of these, they should be easily readable through the range of the rheostat. They need not be readable below the minimum current required for excitation. They should be very accurate, well shielded from external influences, dead-beat, and strong enough to stand rushes of current when the field is switched on or off.

It is impossible to pass over the subject of ammeters without drawing attention to the Weston instruments. To those not familiar with these, a summary of their advantages may be of interest. Unfortunately they are only suitable for continuous currents. The scale is perfectly uniform throughout the range. The action is remarkably dead-beat. The accuracy is very high, it is independent of external influences, and the calibration is not impaired by comparatively rough usage. The current measured does not pass through the instrument, so that it may be used on any part of the board, the connections being two small wires. It is really a voltmeter, measuring a minute difference of potential across a shunt which is placed in the main circuit. Any number of shunts can be connected by means of small plugs to one instrument. A pretty device sometimes used with these ammeters is a luminous scale. The scale is translucent, the gradation lines and figures being opaque. A small lamp fixed behind shows up the reading boldly, so that it may be seen at a distance. The recording ammeter is rarely used, and it is, perhaps, an unnecessary refinement.

Integrating meters, ampere-hour, or wattmeters are hardly switchboard apparatus at present. They certainly would be useful adjuncts, and will probably become general. The usual form of case may be an objection. If the makers would turn out something all over lacquered brass and a reasonable shape, there might be a development in this direction. The same remarks on ammeters with reference to calibrating with a standard instrument might be applied here. The roller form of register instead of dials, in a large size, which could be made of aluminium, would be an attractive feature.

Voltmeters.

It is most essential that voltmeters should be accurate instruments. They must be sensitive to very small changes, and for some classes of work dead-beat. They should be free from temperature errors, and capable of continuously indicating the normal pressure for very long periods. They should always be protected by fuses easily accessible. Remarks on ammeters with reference to static charges on glass covers are applicable in some cases.

There are three distinct classes of voltmeters in every day use, electro-magnetic, electrostatic, and those depending on the expansion of a metal due to heat. The electro-magnetic are not available for alternating currents generally speaking, and except for the purpose of recording instruments, where some power has to be expended in overcoming the friction of the pen on the paper, they do not possess many advantages. The Weston instrument, however, from its dead-beat action and extreme accuracy, is again a favourite. As a voltmeter it can be fitted with a luminous scale, and it is usually provided with a movable index in the shape of a disc, which eclipses a circular aperture in the pointer. This form of index is very easily seen from a distance. Electrostatic voltmeters are useless for recording, and some forms are liable to stick, owing to the very small forces which actuate the pointer. They can, however, be used for alternating and continuous currents, and they consume a minimum of energy. They are most commonly employed for high tension work. Some engineers object to a dangerous potential across an instrument, especially as it has to be observed closely, and frequently tapped to ensure a correct reading. A small sparking gap has to be introduced to protect the instrument, and with concentric mains a momentary rise of potential is common and causes the fuses to blow.

The familiar "Cardew" is a most useful instrument, being applicable for continuous and alternating currents, and is very dead-beat in action. It gets out of adjustment rather too easily, however, and is an awkward shape to accommodate on a switchboard. The horizontal pattern is much steadier than the vertical owing to the steadier rate of cooling. The consumption of energy is rather heavy. In spite of its many defects it is very popular, probably its wide open scale and sensitiveness compare very favourably with rival instruments.

Recording voltmeters are developing, and may now render faithful accounts of electrical pressure. But from some points of view they are still imperfect instruments, since they may sometimes ignore the willingness of the spirit, whilst testifying to the weakness of the flesh. Where these instruments are used, the temptation to tamper with them should be removed, and the interpretation of the charts humane.

Rheostats, Multiple Switches, and Field Switches.

Rheostats are often suggestive of the skeleton in the cupboard. They are unsightly, and the connections are frequently clumsy, even though they may be sound. The choice of resistance material is a matter of great interest. Some alloys possessing excellent qualifications under laboratory tests have been found to have become rotten and brittle after a few years use, or they may suffer mechanical injury during construction, either from bending, &c., or heat applied for soldering. Radiating surface should constitute one of the principal features of the design, ventilation being not an unmixed blessing, as the more air you get through the rheostat, the more dirt and dust is deposited. Compactness is desirable where it can be obtained without sacrificing other advantages. The displacement due to the expansion of the metal while hot must be provided for, and in forms other than the spiral, this is rather an awkward matter. Spirals of wire are unsatisfactory, since they are liable to shake together and interlock if accidentally displaced. They accumulate a lot of dirt, are inconvenient to clean, and also involve comparatively confused connections to the multiple switch. Where a rheostat is only in the field circuit of an exciter and consequently small, it may be wound on a block of slate having a sliding connection along one edge. The slate absorbs a good deal of the heat, which can then radiate from the larger surface. It is objectionable to have the contact on the actual wire, as the wear and any slight sparking might in time cause the wire to break. A great advantage, however, can be claimed from the fact that such an arrangement may be fitted on the board always in sight and kept thoroughly clean. An improvement on this form and suitable for larger work is effected by having special contact pieces fitted, and in the use of several small wires in parallel, whereby a large radiating surface is gained. Tubular resistances would be better still, introducing at the same time additional mechanical advantages.

With reference to multiple switches, besides ample current carrying capacity, there must be exceptional provision for wear, as this may be very heavy. Circular switches, or linear motion derived from a screw, are most usual, but as there is a chance of the operator forgetting for the moment which way to turn the handle, it is preferable, in the author's opinion, to have a lever working through a quadrant in a verticle plane at right angles to the board, the connections being so arranged, that the rising of the handle raises the voltage of the machine.

It is sometimes necessary to make fine adjustments, and occasionally large alterations rapidly, so that a good regulating switch should have two handles, one having a number of intermediate steps between any two steps of the other.

Field switches should always be so arranged that they short-circuit

the windings at the instant of cutting off the current. The author is acquinted with two designs, one by Messrs. Siemens, the other by the Electric Construction Company, which are well suited for this duty.

Synchronising Apparatus.

In alternating current stations this apparatus is of first importance, and should be the object of the designer's special care and foresight. The possibility of a mistake on the part of the operator should be thoroughly investigated. The risk of breakdown in any part of the apparatus having been reduced to a minimum, provision should be made for replacing any defective detail within a minute or two, with no possible chance of reversing a connection, or there should be a simple method of throwing a spare set into circuit. There have been three or more methods suggested for synchronising. First, two lamps, or one lamp and a voltmeter, in series, off the secondaries of two transformers in series, the primaries being one on each of the pair of leads required to be synchronised. Second, a similar arrangement, having a telephone or buzzer to indicate the flow of current through the secondaries. Third, gold-leaf electroscope which can be used direct on 2,000-volt mains. The first method is almost always employed, and it has the advantage of being easily seen by the driver, enabling him to adjust the speed of his engine. This information can also be obtained by lighting the station with alternating current arc lamps. When the armature is at the correct speed, the coil holders appear to be stationary, or revolve very slowly forward and backwards as the speed is too high or too low. It might be almost worth while to switch on a lamp in broad daylight, when synchronising, for this purpose. Where alternate current arc lighting is adopted a gold-leaf synchroniser could be used. It is more secure from breakdown for having no transformer. It is very dead-beat, but at present it has not been developed as a switchboard instrument, and requires modification to preserve the extremely high insulation necessary. While on the subject of synchronising, it is instructive to notice that in English stations an artificial load on the incoming machine is considered unnecessary, although usually employed on the Continent.

In one English station it has been found advantageous to parallel machines through an impedance coil, and then short circuit the coil in two steps. As an extra precaution the paralleling of all machines, up to 400 kw. capacity, is done through a 20-ampere fuse, and this fuse is not blown more than once a month. (It may be mentioned that the armatures are of the coreless type.)

Having discussed the details, the general arrangement and construction of the board may be criticised. Slate or marble are usual as a base, but all holes should be bushed with ebonite, and ebonite plates fixed under all instruments for high tension work. There is a skeleton form, however, made of a lattice work of wood or angle iron, on which the various instruments are mounted. This form is highly efficient from many points of view, but in appearance it is untidy, and it occupies a good deal of room. A recent development consists of a number of cells, made by vertical slate partitions fitted into slate shelves, which are built into the wall. In this arrangement there is, of course, no back, the connections being visible from the front, and carried up through a vertical series of cells.

The commonest form of board is constructed of slate slabs, or panels, having the instruments on the front and all connections at the back. It is the back of such boards that should be most closely watched. It is often necessary to change an instrument, or connect a new machine or feeder, and with high tension current at all points such work is frequently attended with great personal risk. Accumulations of dirt and dust have also to be removed periodically.

Such boards, if designed in a standard panel form to permit extensions, should also have a standard system of back connections suitably protected, and in no case should miscellaneous cable and wire connections be allowed.

On double-pole boards the opposite poles should be far apart, either horizontally or vertically. For the arrangement of omnibus bars and varieties of combinations some reasonable limit should be fixed.

Breakdown terrors are usually more prominent in the minds of high tension engineers. They may stimulate more careful design, but there is also a tendency to run to seed in a progression of combinations. It may be reasonable to have a means of dividing the main omnibus bars, and perhaps have a spare set, sometimes called "hospital bars," for the purpose of connecting any particular circuit or any particular machine.

With reference to the relative position of the apparatus there is a decided preference for the complete set belonging to one generator, or one feeder being in a vertical line, well marked. It is also advisable to have the lines as close as possible, in order that the effect of any adjustment can be watched in the other lines. This principle is so important that where some parts of the apparatus are necessarily large, it might be worth while adding auxiliary gearing to permit of concentration. It is, of course, essential that the handles of all the controlling gear should be within easy reach, and that the indications of all instruments should be accurately readable from a convenient position.

A necessity or temptation to lean or stretch over any portion of the board should never exist.

It seems almost absurd to mention such an obvious precept, yet it is common enough to find a clock which has to be wound periodically mounted on the top of a switchboard. There are boards protected on the front, but this rather encourages carelessness, and is often at the expense of safety at the back. By all means guard against every conceivable accident, but under the roof of a central station a board should be assured from wilful misuse or grossly ignorant handling.

A main switch, fuses, or other safety device, and ammeter, are among the first requisites of a panel; then, perhaps, there may be plug connections, synchronising connections, field switch, and rheostat switch. Voltmeters are usually common to the whole board, and here a suggestion may be borrowed from an American practice—in that of mounting a voltmeter on a swinging bracket from the end of the board. It can then be moved to show to the best advantage at that part of the board where an adjustment is being effected.

Field switches may be advantageously mounted on the machine; by this arrangement there is a saving of conductors, and the man who lets down the brushes may be more confident that the machine is not excited at the time. For continuous current machines the rheostat, and multiple regulating switch, might also be mounted on the machine, or on the wall close by, thereby saving long conductors. Since the electrical pressure regulation is shared between adjustments of exitation and speed, both may be fittingly performed by one man, preferably the driver or dynamo attendant, whose attention can thus be directly called to the brushes at every alteration. Further, it can be urged that fire risks are minimised by distributing the rheostats, and situating them away from the wood platform or other such work in connection with the switchboard. In the case of alternating current machinery, the rheostat switches at least must be on the board, or close at hand.

But there are some alleviations to compensate for the fire risks involved. Alternating current usually means high tension, and the heat generated is of use in keeping the board at a slightly higher temperature than the surrounding atmosphere. There are occasions, when there is a fog, or perhaps in the event of a mishap with steam connections, that this higher temperature may save condensation and consequent troubles.

One of the most pressing considerations in connection with the switchboard, as a whole, is the efficient protection from dust and accumulations of dirt, especially at the back. Not only should elaborate precautions be taken, but an easy and safe means of inspection and cleaning should be a prominent feature of the design.

From an æsthetic point of view, a little license can be granted if all details are well designed. Wood mouldings and panelling add greatly to the general appearance. Some engineers severely cut down anything that is inflammable; this, like everything else, can be carried to excess. When one considers the proximity of such material to an open fire, in an ordinary dwelling house, and the small risk one attaches to it, a little ornamentation on a switchboard appears to be reasonable. There is no necessity, however, to make a switchboard a subject for rococo decoration, and, as mentioned b fore, there are fitter places for a clock than in a surmounting scroll.

With a view to standardisation, another suggestion hails from America. One of the largest firms manufactures unit panels always on a standard size of slate. They make 14 different capacities on a panel 48 inches × 16 inches × 1¼ inches thick, and a blank panel 28 inches × 16 inches × 1¼ inches to go underneath. They are bolted on to steel frames and adapted for unlimited extension. The space required for a switchboard is not of such great importance if correctly estimated when designing the buildings. Too often, however, it has to go somewhere between two windows, in a cramped position, with little or no room for extensions.

The best position is probably on a gallery extending down the length of the engine room, except in belt or rope driven stations, in which case it should be parallel with the drives to be safe, in the event of an accident with the gearing. An elevated position such that the operator can see and signal a driver at the stop valve of any engine is about the ideal.

Though perhaps a little foreign to the subject, a system of engine-room signals might be conveniently touched upon here. It is too small a matter to be treated on under its own heading; but, at the same time, it is important in the administration of duties from the switchboard. In large concerns a well organised system is indispensable, and in small stations, therefore, unorthodox signs should be considered as bad form. The practice of shouting and cat-calling about an engine room, though it may betoken hearty goodwill and enthusiasm among young assistants and pupils, is, to say the least of it, undignified; such cries should be reserved for personal accidents. A regulation whistle or bell, whichever can be more clearly distinguished from the usual hum, should serve to call the attention of drivers. The number of a machine can be indicated by displaying a tablet having both sides painted the same. If the board can be seen from every stop valve, alterations of speed can be signalled by moving an extended hand and arm "up" or "down," the driver signalling the normal speed by moving his hand rapidly back and forwards in a horizontal plane. When the view is blocked, different toned bells, or a number of strokes may be employed, but it is remarkable to find how easily such signals can be forgotten, or confused, after being in daily use for months. Another method is to illuminate a small window, having a word painted on it, by means of a small lamp. Almost any method will answer the purpose provided that it is universal.

Turning once more to the question of standardisation, manufacturers have now had the opportunity of gleaning from innumerable specifications, and of silently witnessing some failures. Perhaps a psychological treatise on the switchbard attendant is still required.

There are, without doubt, some curious instances of irregularities due to absence of mind or fatigue. It is not at all uncommon to see a man feel the bearings and fill the oil cups of a standing machine; but when it comes to the switchboard attendant signalling "raise speed" on a particular engine, the driver adjusting the governor of a *standing* engine, and the attendant signalling back "all right," the subject becomes distinctly interesting. Then there is the man with the laboratory training, who taps every instrument, including the clock and the almanack, before taking a reading. Fuses and plugs have been pulled out while carrying currents. There was a story once of the exciting current being switched off an alternator while running in parallel. Possibly designers have already, or can

easily obtain sufficient information of this description for their guidance.

Once launched on this fascinating theme ideas and suggestions spring like mushrooms. In the interests of science let us suppress the prolificacy of imaginations, born of watching and wakefulness, in the midnight hours.

Leave such work to professional designers who regard inspirations in the positive degree, and to men who live for "estimating," before whose searching gaze the colours and glories of originality pass and die away.

The author has endeavoured to point the necessity of good standard work for switchboards, and to discourage the individual of designing propensities among "Resident Engineers." He is aware that much has been done already towards establishing a standard, but has recently received replies to inquiries from several large manufacturing firms, "we have no standard, as we find all specifications differ."

It should be reserved for the resident or consulting engineer to judge, a representative body of engineers to frame rules and regulations, and for designers and manufacturers to perfect details and study economical production.

In conclusion, the author desires to express his thanks to the gentlemen and firms who have rendered him liberal assistance in the preparation of this paper.

SINGLE v. MULTIPLE GENERATING STATIONS.*

By John F. C. Snell, Borough Electrical Engineer, Sunderland.

This question is one by which doubtless many of us will be met, especially those engineers in charge of direct current central stations, though the question will doubtless also affect to a less degree those supplying alternating current. There is no doubt that too little care has been taken in many cases to gauge the extent of the demand which will be made upon supply stations, and one finds small sites adopted in many cases, or small stations put down without seemingly any regard for future extensions or future uniformity of design. While, on the one hand, it is imperative for the well being of these undertakings to keep down the capital cost per kw. installed, on the other hand, it is foolish and ill advised to pay no heed to the future, and to design the station initially, so that extensions may not be made systematically, and the result be a credit to the designer in the future, and, at the same time, economical to the municipality which he represents.

One cannot overlook the insignificance of many of our stations at the present day compared with, as the author thinks, the dimensions they must attain in the not remote future, and the question which each engineer will have to consider, will be, shall the whole town plant be centralised upon one site (which in most cases would have to be extra-mural) or shall there be several supply stations at different points? The author commenced these notes before the question was raised, at the late Parliamentary Committee and before it had begun its deliberations, and it is interesting to note, that while engineers generally admit the safety of extra high pressure supply, many of the most eminent admit that multiple stations have great advantages. The whole question is determined by the following points:—

1. The critical limit of H.P. installed from the point of economy.
2. Economical generation.
3. Efficiency of distribution.
4. Load factor.

Critical Limit of H.P.—This has been satisfactorily determined by Dr. Alexander Kennedy in the discussion on Mr. Ellington's paper on hydraulic power supply, read before the Institution of Civil Engineers in 1894. The Professor there states that he has found this critical limit to lie somewhere between three and five thousand H.P. installed (Mr. Ellington's limit being much lower) and once this limit is reached, it is just as economical to build another station, as to go on increasing the capacity of the first. This point being conceded, the questions of site, nuisance, and economical generation will be considered below. The author's opinion is, that given sites obtained with economy and carefully chosen, that this principle of multiple stations is the right one, inasmuch as other factors, such as additional safety and reduced capital outlay on mains, and increased efficiency in distribution are thereby obtainable.

Economical Generation.—It is impossible, of course, to lay down any standard on which a town supply can be based. But no doubt the ideal to be aimed at is a direct current system, with its simplicity, availability for power purposes, possibility of storage (which we may hope will yet greatly improve) and its undoubted reliability; condensing plant with its added efficiency, reduced charge for water and boiler cleaning; and a convenient position for economically obtaining coal. It is impossible, except in rare cases, to obtain these advantages as it were naturally, *i.e.*, to find a site, at once alongside of water, and a railway siding. By far the greater number of towns will have to adopt auxiliary means for cooling circulating water, if they must needs obtain the advantages of condensation, and it would therefore seem that in many cases it is unnecessary to build stations outside a town, the only factor against this being the increased cost of the sites in more central positions, but which may well be outbalanced by the cost of mains to various sub-centres, when one generating station is adopted. In the City of London no doubt, the case is a specially peculiar one, but in the other large cities and towns there are plenty of available sites which would be easy to obtain, where the station may be practically erected *on* the mains it supplies. The question of a slight charge on the coal for cartage, or even the much more pronounced one of condensation, may be much outweighed by the inefficiency of the distribution. That a site situated by a river, for example, where surface condensation may be obtained, is one of the greatest blessings that a station can have will be admitted, but not so if a system has to be adopted which entails an inordinate price for trunk mains and repeated transformation.

Distribution.—It may be taken as an axiom, that simplicity of distribution is desirable, and even necessary, and we shall find that out more and more as time goes on, also that the lower the pressure adopted, consistent with economy, the safer and more reliable the supply. One does not want to rake up the old discussion of the pros and cons of alternating and direct currents, but let these remarks apply to all stations of both classes; therefore, from these points of view alone, multiple stations with simple radiating feeders appear to provide the simplest system obtainable. It cannot be overlooked that the amount of conductors radiating from one huge extra-mural station, would sometime become enormous, and expensive culverts would have to be constructed.

Capital Costs.—Multiple stations are not any dearer to construct than single generating stations, for if one analyses the costs of one of the London companies, or municipal towns having multiple stations, and bears in mind the relative miles of streets covered by their distributing mains, one will find very little difference in the cost of the two systems at this earlier stage, and one may venture to say that the difference as the load increases will be in favour of those stations which are fixed directly on the centre of gravity, as it were, of the system which they supply.

Load Factor.—There does not seem to be much in this point. If anything there is a chance of a better load factor at several stations than with one large and distant one. Take a system which is supplying light and power, and supplying tramways, there can be no doubt that the system will have a better efficiency of distribution when several stations are erected; will be better able to deal with the requirements of the tramways and leakage; and better able to solve the problem of the decreasing space in the streets available for mains. The load factors of Glasgow and Liverpool, with multiple stations, or at Westminster, are as good as towns of equal importance where the whole supply is from one station, and the proportion of maximum load to plant installed much the same. So there is not much in that argument against multiple stations.

Nuisance.—Objections which may be raised to intra-mural stations are:—

1. Cartage of coals and ashes.
2. The absence of natural means of condensation of steam.
3. Smoke nuisance.
4. Vibration.

(1) The extra 8 or 9 per cent. payable on coal for cartage (as may happen in the case of multiple stations), may be much more outweighed by the decrease in efficiency of distribution when the station is outside the town, added to which must be the interest on the capital cost, which the extra mains entail.

(2) *Condensation.*—This has been touched on before, and, as has been said, probably the majority of stations in future will have to provide artificial means for dealing with the circulating water if condensation of steam is to be adopted. Those stations which have some natural source, such as a river or the sea, will no doubt have the advantage, and he would be unwise who would omit to seize these opportunities, if they are at all possible. The saving which may be obtained from the reduced consumption of steam, and consequently of coal, the absence of any charge for feed-water, and the less cost of cleaning the boilers are the advantages. Doubtless, therefore, there are cases where the economics of this problem can be better met by centralising the plant (probably in the future this may mean three-phase plant), where this great engineering advantage of condensation can be obtained, and the supply re-distributed from multiple sub-stations.

Vibration.—This point which has been raised as a deterrent to the adoption of stations inside certain towns is one which, with care in dealing with the foundations and formation on which the station is erected, and by the adoption of three-crank engines, can be neglected. Atmospheric exhaust vibration is a matter which can be easily got over by exhaust silencers, or, of course, by adopting condensing plant.

Smoke Nuisance.—This point is mentioned because often brought forward as an argument for extra-mural stations. One may confidently say that in these days there are few of us who would care to admit that our stations would be complained of from this point, and with careful stoking and management the smoke nuisance is more visionary than real.

To briefly summarise, the actual problem we are confronted with, is that a station already exists, and we have to extend with both financial and engineering success, and our respective committees will not care about large alterations being ultimately made by the substitution of existing plant by other systems. The most natural method therefore seems to be this, to prospect new areas by high tension direct current machinery, where possible, with sub-stations feeding into low tension networks, the latter so designed that ultimately they may become part of the general network into which the second or more stations will ultimately feed, these taking the place of the temporary sub-stations.

This paper contains nothing new, and is intended merely to be a basis on which the arguments for and against the principle enunciated may be thrashed out, and I must apologise to the members of the Association for what may well be considered a plagiarism.

* Read June 9th.

MANAGEMENT OF ELECTRICAL UNDERTAKINGS BY LOCAL AUTHORITIES.*

By Councillor Hesford, Ex-Chairman of the Electricity Committee of the Southport Corporation.

It calls for no great demand upon our credulity to-day to assume that electrical undertakings can be efficiently administered and profitably managed by local authorities.

* Read June 8th.

We have evidence of this sufficient to convince the most sceptical, even Government departments. Yet, with such evidence plainly before us, the anomaly remains that of the total number of provisional orders annually obtained, many drift into and dwell for years in the regions of the doldrums. Here pessimistic majorities love to dwell until leavened by the optimists when the good ship soon finds its way into the trade winds. Having arrived in such active sphere, committees generally exhibit a desire to understand something of the work they are called upon to do. Nay, their zeal is generally worthy of emulation by every manufacturing committee of corporations. Some are even as jealous as the boy who took the bellows to pieces to see from whence the wind arose. It is a new thing, is a common remark, and who does not like to see and hear of something new.

Having taken their decision to establish a station, alas, difficulties face them at all points. Shall an engineer be at once engaged to design and subsequently work the station, or is it better to call in the advice of some consulting engineer to advise and plan. To approach the makers of machinery at this point, as private individuals do in building factories and works, is rank corporate heresy. On such a mementous question members seek advice from those of their friends who have already gone through the mill. But here diversity of opinions is the bewildering fruit of their efforts. Every committee know what they want. It is a station and system of distribution that shall be second to none. It must be planned for utility and convenience, and meet the unknown wants of futurity. Its machinery should be designed to adapt itself with precision and success to all the varying requirements, work at a cost that shall top the record, and be obtained from the lowest tenderer. These are the ideals, and the question is how to get them.

Friends tell us privately that consulting engineers are divided into schools, and that somehow or other their district will be found to be well suited to the particular system that the engineer called in generally advises. The advantages of such system are explained and made manifest, whilst the disadvantages of others are clearly portrayed.

Having read or remembered something of the battle of the gauges fought by railway engineers in the first half of this century, and its termination by the evidence of convenience, members of committees subside into despair of being able to give a clear reasoned decision on any system. In this condition the influence of persuasive oratory generally prevails and soon seals their capture.

An engineer is engaged and a suitable system declared.

Should the committee continue in the jelly-fish condition produced by abundant and earnest advice of opposite polarity, they will be spared the distractions of listening to the arguments of Lancashire *versus* water-tube boilers, or high speed *versus* slow speed engines, one advantage of being in a plastic condition of mind. The station being now completed, committees for a time at least are rid of their perplexities and difficulties. This is for a short time only. Errors in design and equipment soon make themselves apparent. Our buildings are too narrow or too short is a frequent cry. But that much belauded day plant is the dilemma of most committees. Having been at work a year or two it leaks out gradually that the small unit specially advised for economical day load work is too small, and of insufficient power in some cases to energise the transformers alone.

We are advised to sell them, but to whom? If the Asiatics could be induced to take them as readily as they take modern rifles, what a relief to corporations and benefit to the buyers it would be. The advice is frequently given to sell this or scrap that, often advisable and perfectly sound from a business point of view, must or ought to bring to every committee the concomitant duty of making a reserve fund, out of which the unpaid sinking fund on such plant can be met.

But the primary and foremost duty of committees having stations under their control, ought to be the production of electrical energy at the lowest possible cost. None need be at loss for a standard whereby to measure such costs. With the excellent and up-to-date tables in *Lightning* the failings of every station becomes apparent. Certainly few, if any, can excel in every item of costs in the group into which they as measured by output fall. All can, however, try to stand well by comparison where skill and forethought in design and equipment, as well as management make themselves felt.

The policy of willingness to lay cables to supply proposing or likely customers has hitherto been attended with general success. Of the day when it will become the poor man's light, we all anxiously await the dawn. Whenever the cost of distribution can be cheapened considerably that day will have arrived. Everyone connected with electricity committees remarks on this at present very costly process.

Street Lighting.—Electricians all advise, and wisely no doubt, the lighting of our streets with electricity. What a smug satisfied look would pass over the face of every corporate electrical engineer if he could obtain it.

The nice 3,000-hour load factor would delight him. How is this desirable change to be brought about. The prize is worth every effort. But all here know that corporate gas committees are tough thick-skinned gentlemen. The one lever that would be rapid and successful in gently lifting them from their commanding position is the one of less cost. Bring that about by whatever means you like, and the object of our desire is attained.

Charging.—No paper on management would be complete without reference to the prices charged. In this matter corporations stand well in comparison with private companies. By a large and constantly increasing number the Wright system of charging is finding favour. Personally, I am strongly in favour of retaining the maximum price, intact, setting the time limit of such price to suit the circumstances of each locality. For all energy consumed beyond the time of maximum price, I would drop it to the lowest possible charge consistent with covering all charges.

A reserve fund I deem a necessity.

In a word my policy would be one of charging the lowest price the system will bear, rather than the one that generally obtains in the gas world of charging the maximum that the public will quietly consent to pay. In conclusion, as an earnest member of committee, let me add that it will be the opening of a grand day for the popularity of electric lighting, when the greater portion of the capital, energy and resource now expended by electricians on various schemes for improving steam engines and boilers, shall be spent on the cheapening and perfecting of the means of distributing energy for lighting purposes. An average of from £8 to £10 per connection is a very heavy capital charge to carry.

The interest and sinking fund on this amount is equal to one-third the annual cost of light in cottage houses.

Nor as a member of a corporation can I ignore the fact that the calamities that we were almost passionately pressed to anticipate and guard against by the expenditure of capital on duplicates have not generally shown themselves in practice.

Accepting the press as my authority, the major portion of failures in lighting have occurred in consequence of weakness or defects in the distributing plant.

Our boilers, steam pipes, and engines have not failed so often as the underground portions of our systems. It is on this portion of the plant that members of committees entertain a fear, that is fruitful of halting and indecision.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The Design of Electric Railway Motors for Rapid Acceleration. By Prof. Charles A. Carus-Wilson, Member. Read May 26th, 1898.

(*Continued from page* 785.)

From equation 16 we find the accelerating current to be 30 amperes; so that the total current at starting is 45 amperes, assuming that the induction factor remains constant throughout. These results are shown in fig. 5. Horizontal ordinates represent time in seconds, and vertical ordinates speed in feet per second, and also amperes.

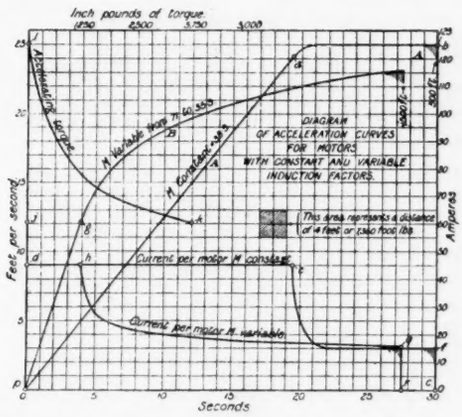


Fig. 5.

The acceleration is 1·25 f.p.s. per second, and can be kept constant until the starting rheostat is all out. The speed at which this takes place can be found from equation 6, by inserting the known value of $\frac{M v}{d}$, and putting $E = 500$, $R = 0{\cdot}6$, $C = 45$. We find that the speed is 24·2 f.p.s., or 97 per cent. of the final speed. The error involved in assuming that the acceleration is constant up to full speed does not amount to 1 foot of distance. From the figure we see that half the distance is covered in 20 seconds during the process of accelerating, and the remaining 250 feet is covered at full speed in 10 seconds. The whole area of the curve $p\ a\ b\ c$ represents 500 feet.

The maximum current, 45 amperes, is constant up to the point a, when the starting rheostat is all out. This is shown by the current-curve. At the point e on this curve, corresponding to the point a on the acceleration curve, the current will rapidly diminish; the form of the curve has been calculated and plotted in the figure.

We must now consider the influence of series winding on the curves of current and acceleration. In fig. 6, let values of the current be measured horizontally, and values of the induction factor be measured vertically. Take $a\ h$ equal to 15 amperes, and set up $h\ b$ equal to 35·5 on the vertical scale. Then b is a point on the induction curve of the motor. For, whatever are the values of M for large currents, the value of M for 15 amperes must be 35·5 in order that the motors may run at the required rate at full speed.

Take $a\ g$ equal to the maximum current, 45 amperes. Produce $a\ b$ to cut a vertical line through g in c. The greatest possible in-

duction factor the motors can have at 45 amperes is given by $g\,c$, equal to 106 on the M scale. For the induction curve of a series-wound motor cannot be convex to the axis of current, though it may be a straight line passing throughout the origin if no part of the iron in the magnetic circuit is magnetised over the bend of the magnetisation curve. We have shown in this case that the induction curve must pass through the point b; hence the greatest possible value of M for these motors is found by making the induction curve a straight line passing through b, giving us a maximum induction factor of 106.

Our calculations hitherto have shown us that the motors must have an induction factor of 35·5 at 15 amperes, and that the maximum current at starting must be 45 amperes. We have not, however, determined the value of the induction factor at 45 amperes. All we know is that if M is constant, and equal to 35·5 for all currents, we shall cover the given distance in the given time.

It is clear that there are an infinite number of possible induction curves, all passing through the point b, having different values of M for 45 amperes, all less than 106. Any one of these curves would

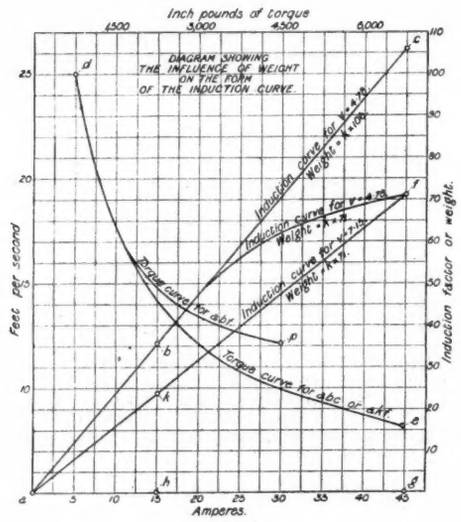

Inch pounds of torque
DIAGRAM SHOWING THE INFLUENCE OF WEIGHT ON THE FORM OF THE INDUCTION CURVE.
Induction curve for W = a b c.
Induction curve for W = a b f.
Induction curve for W = a b.
Torque curve for a b f.
Torque curve for a b c or a k f.
Feet per second
Induction factor or weight.
Amperes.

Fig. 6.

comply with the specification as to time and distance, but we shall see that none of them would be so good from the point of view of economy as the line $a\,b\,c$.

When the maximum current to be carried by a motor is fixed, the weight increases nearly in proportion to the induction factor for that current. We shall assume that for any current the weight is given by k times the induction factor for the current, where k is some constant. Hence, of all induction curves that might be chosen, that given by $a\,b\,c$ will involve the greatest weight.

Let us suppose that the practical considerations of space and cost limit the weight of the motors in this case, so that the maximum value of M for 45 amperes is 71—twice that for 15 amperes. The induction curve must then pass through the points $a\,b\,f$; let the curve $a\,b\,f$ in the figure be the curve chosen.

From the induction curve we can construct a curve giving the total torque available for all purposes. In the figure this is drawn at $d\,p$, horizontal ordinates giving torque in inch-pounds on each motor axle, and vertical ordinates speed in feet per second. By deducting from the horizontal ordinates of this curve the torque required to overcome the retarding forces we obtain a curve of torque available for acceleration. This curve is reproduced at $l\,k$ in fig. 5; it cuts the speed axis at 25 feet per second.

We can now construct the acceleration curve for the series-wound motors. The maximum total torque is 4,500 inch-pounds; deducting 750 inch-pounds for the retarding forces, assumed to remain constant at all speeds, we get an initial acceleration of 3·12 f.p.s. per second—more than twice that obtained when M was constant. The speed of the car when the rheostat is all out is 12·1 f.p.s.; this speed is reached in about 4 seconds, and is shown by the point g. From p to g the acceleration is constant. The form of the acceleration curve beyond this point has been found by graphic construction, and continued up to the point at which the area, as obtained with a planimeter, is equal to a distance of 500 feet; this is at 27·5 seconds from the moment of starting.

The current curve has also been drawn. The maximum current is passing for 4 seconds, after which time the current decreases; the value at any time being obtained from the acceleration curve by using equation 6. An examination of the curves in fig. 5 shows that the effect of increasing the induction factor by series winding has been to decrease slightly the time required to cover the given distance, the saving of time in this case being 2·5 seconds.

If we compare the acceleration curves for the constant and variable induction factors, we shall see that the series-wound motor gains in distance up to the point at which the curves cross one another, and after this point loses in distance. If the distance gained is equal to that lost, there will be no difference in the time required to cover a given distance. This may often happen. The form of the acceleration curve depends upon that of the curve of accelerating torque. If this is nearly straight between k and l, the acceleration curve will rise up steeply, and the gain in time may be considerable. If, on the other hand, the torque curve is very much bent, the acceleration curve will bend over rapidly, and the series-wound motor will take a longer time to cover the given distance than one with constant induction factor.

The form of the torque curve depends on that of the induction curve. Hence, the straighter we can make the induction curve the shorter will be the time required to cover the given distance.

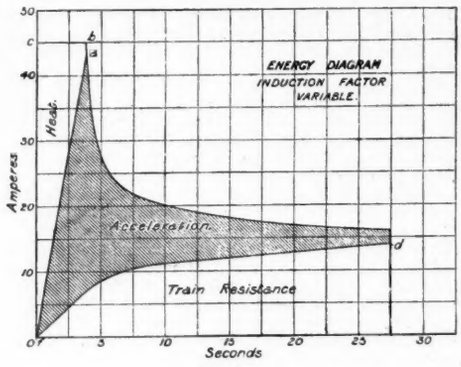


Fig. 7.

A ratio of maximum to minimum induction factor of two to one is very commonly obtained, and in such a case the series-wound motor may show a gain of 5 to 10 per cent. in the time occupied. We have, then, a reason why the induction curve should be as straight as possible.

The energy expended in covering the given distance is shown in each case by the area of the current-curve. A glance at the diagram is sufficient to show how great a saving is effected by the use of the series winding.

The two current-curves have been reproduced in figs. 7 and 8. If we multiply the vertical current ordinates by the tension of the line, we may take these to represent watts instead of amperes. At the point f the whole of the energy is being expended in heat. The heat loss at any point may be calculated by finding the speed and the resistance in the circuit, and then multiplying this by the square of the corresponding current. If the heat watts is divided by the tension of the line, we obtain the part of the total current that represents the loss due to heat.

When the current representing the heat loss has been deducted from the total current at any instant, the remainder represents the expenditure of energy in producing acceleration and overcoming train resistance. The proportion of these two can be obtained from the curve of total torque, since that tells us how much is being used for accelerating, and how much for overcoming train resistance at any speed.

The curves $o\,a$ and $o\,d$ in figs. 7 and 8 have been constructed in this way, thus dividing the whole area into three portions, representing respectively the energy used in heating, in accelerating, and in overcoming train resistance.

In comparing the two diagrams we see that the areas giving the energy used in overcoming friction must be the same; for the distance

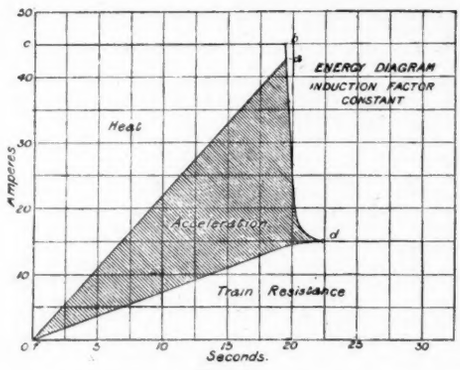


Fig. 8.

is equal, and so is the frictional resistance to motion. In this case the energy thus expended is, by calculation, 109 thousand foot-pounds.

Since the final speeds in the two cases are respectively 25 and 23·2 feet per second, the kinetic energy for the motors with constant and variable induction factor will bear to one another the ratio of the squares of these numbers. The values are, by calculation, 109 and 88·7 thousand foot-pounds. There is thus a small gain in favour of the series-wound motors, owing to the fact that the final speed is less than with the motors with constant induction factor.

It is, however, when we come to consider the areas representing

the heat loss that we see wherein lies the great advantage of the series winding. The energy expended in heating with the motors having constant M is more than five times that expended with the series-wound motors, the actual values being 32·2 and 169 thousand foot-pounds respectively.

Examination of the diagram shows that the area giving the heat loss is very nearly one-half of the area of the current-curve up to the point at which the starting rheostat is all out. Now, the effect of the series winding is to reduce the time during which the starting rheostat is in the circuit. And this reduction is brought about in two ways. First, the speed at the point when the rheostat is all out is reduced in direct proportion as M is increased. Second, the increase in the initial acceleration sets back this point still further. Thus, in fig. 5, the point a gives the moment when the rheostat is all out with constant M. The speed is 24·2 f.p.s. If M at the start is doubled, owing to the use of series winding, the speed is reduced to 12·1 f.p.s., and the point g then still further set back, so that the time is reduced from 20 seconds to 4 seconds.

Since the speed when the starting rheostat is all out varies nearly inversely as M, and the initial acceleration varies nearly directly as M, the area giving the heat loss varies nearly inversely as the square of the induction factor at the moment of starting.

By increasing the induction factor indefinitely we could reduce the heat loss to that due to the resistance of the motor only; in other words, we could do without the starting rheostat altogether. The reason why we are unable to do this is because the maximum possible value of M is determined by the form of the induction curve. Thus, we have seen in fig. 6 that in this case the greatest possible value of M is 106. If the weight involved in using this value of M were not an objection, we could reduce the heat loss to 13,000 foot-pounds. Such a value for M would, however, be inadmissible, on account of the cost of construction and the space taken up, and we have to be content with a loss two or three times this amount.

A reference to fig. 5 shows that the points, such as a and g, where the rheostat is all out lie on a curve passing through the origin. This curve is nearly a parabola, whose horizontal ordinate varies inversely as M^2. It is thus evident that, the more the heat loss is reduced, the greater will be the increase in M required to effect any further reduction; so that there is a point at which it is not worth while increasing the weight of the motor, the saving effected not being large enough to compensate for the disadvantages of the heavier motor.

The following table shows the expenditure of energy in foot-pounds in the two cases:—

	Constant induction factor.	Variable induction factor.
For acceleration	109×10^3 ...	$88·7 \times 10^3$
For train resistance	109×10^3 ...	$109·0 \times 10^3$
For C^2 R loss	169×10^3 ...	$32·2 \times 10^3$
	387×10^3	$229·9 \times 10^3$

The expression "train resistance" means here all forces opposing the motion, including those due to the friction of the gearing and the torque lost in the motor itself.

Referring once more to fig. 6, we have seen that the induction curve of the motors must pass through the point b, and that if the maximum value of M is limited to 71 the induction curve must be bent so as to pass through the point f.

If now the velocity ratio employed can be increased, in the ratio of 71 to 106, or—what would come to the same thing—if the diameter of the driving wheel can be decreased in the same ratio, the induction factor at 15 amperes must be reduced to 23·8, so that the final speed may remain unaltered. Let $h\,k$ equal 23·8 on the M scale. It follows that a straight line through a and k will cut the vertical line through g at f, where $g\,f$ is equal to 71 on the M scale.

We have thus made our induction curve pass through the point of maximum M for 45 amperes, and $a\,k\,h$ is the best induction curve from the point of view of economy. We have done this by simply increasing the velocity ratio and altering the inclination of the induction curve to the axis of the current. This inclination will depend upon the permeance of the air-gap if the iron circuit is unaltered. Hence, by rightly proportioning the gap and the velocity ratio, we can obtain results approaching very nearly to the greatest possible economy.

Since $h\,k$ in fig. 6 is equal to $0·1747 \frac{e\,t\,d}{D\,v}$, and $a\,h$ is equal to $2·03 \frac{T\,D}{e\,t}$—T being the retarding force in pounds at the car axle—the tangent of the angle $k\,a\,h$ is given by

$$\tan k\,a\,h = 0·086 \frac{e^2\,t^2}{T\,D^2} \frac{d}{v} \qquad (18)$$

Hence we can write,

$$p\,A\,S\,g = 685 \times 10^4 \times \frac{e\,t^2\,d}{T\,D^2\,v} \qquad (19)$$

where p is the numerical constant defined on page 1, A is the number of surface conductors, S is the number of turns per pole in the series winding, each carrying the whole current, and g is the permeance of each polar gap in centimetres.

It will generally happen in practice that the weight limit requires a velocity ratio that is unattainable even with the largest values of d. We have here a difficulty that influences greatly the design of railway motors when spur gearing is employed, namely, the limited clearance between the gear wheel and the ground. We have to get the largest value of v with the smallest value of d. It is obvious that the greatest possible ratio of v to d is determined simply by the clearance.

(To be continued.)

ELECTRICITY AND THE WAR.

THE interest in the war is well maintained in the columns of our American electrical exchanges. We have already stated the opinions of two journals regarding the probable effect of the war upon the electrical business in the States. It was considered that the war would place the electrical trade in a bad way eventually. The New York *Electrical Review* seems to take an entirely different view. It says that the only apparent effect of the war on the electrical industry in the United States has been to set the majority of the manufacturing plants running day and night. The wire and cable companies are overburdened with orders, chiefly from the Government. Makers of dynamos, motors, searchlights, ship-lighting sets, and small supplies are also unusually busy. Many of these companies are working short-handed in their administrative forces, owing to the fact that a considerable number of their people have volunteered their services to the Government in various capacities. The war will result in profit to the electrical industry, and the electrical fraternity has been and will be of invaluable assistance to the Government.

It is interesting to note that among the officers attached to Dewey's squadron was Lieut. Bradley Fiske, who is well known to the electrical fraternity as the inventor of the Fiske range-finder, and for his electrical work in other directions. Lieut. Fiske was on the *Petrel*, and it was his ship to which the task was assigned of destroying the remnants of the Spanish fleet after the battle was over.

It is to be hoped that the volunteer electrical corps, which is being rapidly organised by Capt. Eugene Griffin, Dr. Louis Duncan, Lieut. F. J. Sprague, Lieut. O. T. Crosby, and others, will not be placed on the same footing as other volunteer corps recruiting for other purposes. The electrical volunteers' immediate superiors will be men in his own line of work, whose ability he recognises. Our New York namesake remarks, "The volunteer electrical corps does not and need not know military tactics—it must and does know how to handle a pair of pliers."

In connection with the war news it is interesting to print the following telegram sent by President McKinley to the Electrical Exhibition, on its opening in Madison Square Garden, New York, early last month:—

"It gives me pleasure to open the Electrical Exhibition in Greater New York, and to participate in this demonstration of the latest method of transmitting, recording, and publishing by means of electricity. I congratulate you upon the achievements of American genius. I am glad to know that the resources of the wonderful electrical arts have already been so far advanced in the United States, that American electrical goods are welcome the world over."

In regard to the action of Admiral Dewey in cutting the telegraph cable at Manila, the New York *Electrical Engineer* says: "He cut the cable, but what a grand thing it would have been if he had had with him some good cable men who could have taken hold of the cut end and kept one of his ships in touch with the outer world." The battle of Manila offers an illustration of the wisdom of having experts in telegraphy and electrical engineering attached to every army or fleet. "If the electrical end of Commodore Dewey's establishment had been cared for as scrupulously as its strictly fighting end, he could have made his victory even more complete in its moral effect by showing the Spaniards the hopelessness of a war against so ingenious a people as ours. There is one brilliant electrical engineer with the Dewey fleet, Lieut. B. A. Fiske, but he is helpless while the cable lies at the bottom in deep water, for of all the ticklish things to hold and raise a heavy cable is about the worst."

On the legality of Admiral Dewey's act, the *Western Electrician* says:—"It is generally held that all nations reserve to themselves the right to cut submarine cables in wartime as a military necessity or belligerent right, but it is possible that a civil claim for damages to the service may be admitted."

At the request of Lieut. Maxfield, U.S.A., the Government censor, all the foreign employés in the offices of the United States and Hayti Cable Company in New York have been "laid off" from the company's service, their places being filled by native-born American citizens.

HEAVY MOTOR VEHICLES AT LIVERPOOL.

NOT much attention has been accorded to the trials of motor vehicles made recently at Liverpool by the local Self-Propelled Traffic Association, the object being to arrive at a type of heavy motor waggon suitable for trade requirements in and around Liverpool. Though entries were numerous, only six British vehicles were entered, and all the Continental vehicles were excluded by the 3 tons limit of the Light Locomotive Acts of 1896. Only four vehicles finally competed, yet they attracted a good deal of local interest, and numerous light motor vehicles were employed in carrying judges and others over the course.

All the competing vehicles were steam-driven; there were no oil or electrical vehicles, though oil was represented well among the light attendant carriages, all of which were sent by the Daimler Company of Coventry.

Two exhibits came from the Steam Carriage and Waggon Company of Chiswick. No. 3, of Class II, which comes under the figures of minimum load 5 tons, minimum average speed 4 miles an hour, minimum platform area 110 square feet. It was carried on 6 wheels, and is described by the *Times* correspondent as resembling a traction engine with attached waggon. It and its smaller companion, No. 4, had water-tube boilers and an air condenser. Vehicle No. 1 was sent by the Liquid Fuel Company, of East Cowes. It was entered under

Class I., minimum load 2 tons; minimum speed 6 miles per hour; platform area, 60 feet. It ran 35 miles in 5 hours inclusive of all stops, a very creditable performance.

The Lancashire Steam Motor Company, of Leyland, were the owners of the fourth vehicle, which carried 4 tons, and was built for 6 miles per hour, and was carried on 4 wheels with a steel frame, and the boiler is below the platform. Its steel tyred wheels gave a deal of trouble, so that on the third day it did not turn out. Gradients of up to 1 in 20 were found on the various trial routes selected, and a report is promised at an early date. Present appearances point to the heavy motor car traffic being monopolised by steam-driven vehicles, whereas for light cars oil motors seem best, though for city work on smooth pavements electricity holds the place, as evidenced by the London electrical cabs, which still seem to be running satisfactorily and regularly, being daily in evidence all over the city and west end.

Had it not been for the hampering restrictions regarding road locomotives, the motor vehicle industry would to-day have been in a flourishing condition, and it would not have passed through the undesirable phase of company promoting, which has so much retarded honest development.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by W. P. Thompson & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*

11,570. "Improvements in or connected with electrolytic cells." G. Bell and G. W. Bell. Dated May 23rd.

11,579. "Improvements in electric signalling on railways." J. W. Wadkin and D. J. Jarvis. Dated May 23rd.

11,604. "Improvements in or connected with the electro-metallurgic production of iron steel and their alloys with chromium tungsten, nickel, manganese and the like." E. Stassano. Dated May 23rd. (*Complete.*)

11,609. "An improvement in electrical fuses and cut-outs chiefly applicable to the bridge fuse." A. W. Sowby and H. E. Munslow. Dated May 23rd.

11,610. "An automatic electrical temperature indicator." A. H. Wood and D. M. Haylings. Dated May 23rd.

11,627. "Improvements in electric cables." W. S. Smith. Dated May 23rd.

11,640. "Improvements in accumulators or secondary batteries, and apparatus for their manufacture." F. Heimel. Dated May 23rd.

11,678. "Improved apparatus for use in the electro-deposition of metals." W. Dunn and W. J. Twining. Dated May 23rd.

11,723. "Improvements in and relating to the making and breaking of electric circuits." J. A. Steven and C. Hamilton. Dated May 24th.

11,730. "Smethurst concentric ceiling rose." A. A. Smethurst. Dated May 24th.

11,731. "Improvements in the globes of electric incandescent and similar lamps." English Industrials, Ltd., and G. E. Heyl-Dia. Dated May 24th.

11,732. "Improved means for measuring current or voltage in electric lamps." English Industrials, Ltd., and G. E. Heyl-Dia. Dated May 24th.

11,757. "An improvement in jointing or junction boxes for connecting, distributing, and the protection of electric wires." T. McEwan. Dated May 24th.

11,773. "Improvements in connection with permanent magnets." C. Thompson. Dated May 24th.

11,783. "Improvements in and relating to conductors for electric railways." H. H. Lake. (W. A. P. Willard, jun., United States). Dated May 24th. (*Complete.*)

11,858. "Improvements in the manufacture of elements or plates for secondary batteries or electric accumulators." F. King. Dated May 25th.

11,860. "An improved means for making and breaking electric circuits." A. W. Sauerbrey. Dated May 25th. (*Complete.*)

11,880. "Improvements in, or relating to, coils for heating by electricity." A. Cleaver. Dated May 25th.

11,906. "Improvements in, or relating to, fuseboards." A. Vandam and T. H. Marsh. Dated May 25th. (*Complete.*)

11,917. "Improvements in means for silvering or plating the glass bulbs of incandescent electric lamps, or the like." F. Fanta. Dated May 25th.

11,922. "Improvements in electric lamps." A. A. C. Swinton. Dated May 25th.

11,924. "Improvements in electric lamps." W. Peto. Dated May 25th.

11,926. "Improved circuit connections for continuous current shunt machines." A. Sengel. Dated May 25th.

11,936. "Improvements in electric arc lamps." R. Gaynor. Dated May 25th.

11,989. "Improvements in, and relating to, telegraphic transmitting and recording or receiving apparatus." J. C. Mewburn. (B. Hoffmann, France.) Dated May 26th.

12,011. "Improvements in electric gas-igniters." F. Deimel, J. Lehmann, and A. Sylten. Dated May 26th.

12,013. "Improvements in printing telegraphs." L. Kamm. Dated May 26th.

12,016. "Improvements in systems of electrical control." H. H. Leigh. (F. J. Sprague, United States.) Dated May 26th.

12,019. "Manufacture of active material for accumulator batteries." H. Tobler and J. H. Graeber. Dated May 26th. (*Complete.*)

12,049. "Improvements in electrical resistance coils." S. W. Cuttriss. Dated May 26th.

12,092. "Improvements in electric bells for cycles." A. R. Gould. Dated May 26th.

12,106. "A new or improved electrical appliance for curative or remedial purposes." H. Krauss. Dated May 26th.

12,172. "Improvements in electric arc lamps." K. Panian and M. Bernhard. Dated May 28th.

12,175. "A new or improved composition for the manufacture of carbon pencils for arc lamps, incandescent filaments, and the like." C. Schnabel. Dated May 28th.

12,190. "An improved chemical composition intended for the manufacture of mantles or blocks for use in electric arc lamps." P. Mersch. Dated May 28th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 9*d.*, *(in stamps).*

1897.

17,924. "An improvement in field magnets for electric generators and motors." C. Tuson. Dated July 30th, 1897. This invention relates to the construction and winding of a field magnet, so that the coils employed can be easily wound ready to be put in place. A hollow cylinder of steel is made with deep recesses in its ends, leaving an internal shell cut away at each side to leave opposite pole pieces. Two insulating wires are wound, each forming a complete ring. Each of these rings have their sides introduced at both ends into the recesses and are passed through the cylinder. They cross each other on each side of the cylinder and when electrical currents are passed through the rings the cylinder is rendered magnetic, and the inner face on one side being of one polarity, and the opposite face being of the opposite polarity. 1 claim.

18,276. "Improvements in electric lamps for miners' use." H. H. Lake. (Communicated by O. Siedentopf.) Dated August 5th, 1897. This relates to a novel arrangement of terminal openings, and of protecting the dome; covering the lamp bulb. The protecting dome is of glass and is hinged upon the casing of the lamp in such a manner that it swings downwards when opened, so that the lamp can be readily replaced. It also covers the terminal openings for charging the secondary battery in the lamp; as they are arranged upon the front of the lamp so that when the dome is closed the contact pieces are prevented from becoming dirty. 2 claims.

1,996. "Improvements in electric rollers for therapeutical and massage purposes." J. W. Gibbs. Dated January 25th, 1897. Date applied for September 22nd, 1896. This invention is an electric roller consisting of a central body provided with axial bearings for the handle. There are a series of contiguous generating face-plates, as copper and zinc, around the centre of the body. The face of the roller is smooth and a circuit is established by the moisture of the body upon application. 2 claims.

13,268. "Improvements in electric mountain railways." E. Andre. Dated May 28th, 1897. This relates to a device for increasing the tension of the dynamo during the down journey without dangerously increasing the speed of the car. There is an arrangement enabling the motor to act as a dynamo, irrespective of the kind of current used, and to impart current to the line wires by increasing the number of revolutions. There is also an additional dynamo adapted, to be connected up with the motor in series, in order to increase the tension of the latter by means of its own tension and to act at the same time as a brake. 2 claims.

17,824. "Improvements in electric alarms for cars." A. Nathan. Dated July 29th, 1897. This invention consists of a vertical shaft, at the upper end of which is pivotally connected a spring-supported lever, provided with an arm directed downwards, mounted on the shaft, below the lever is a vertically movable disc supported by springs. To this disc there is fastened a tubular insulating sleeve, which is free to move up and down the shaft with the disc. At the bottom of the sleeve is fastened a plate. Below this is another plate mounted on the shaft by an insulating sleeve rigidly fixed. There is an electric bell in circuit with these plates, and when the lever is pressed down the plates touch, which closes the circuit and operates the alarm. 3 claims.

5,131. "Improvements relating to electrical resistances." E. W. Bowles. Dated March 25th, 1897. This relates to liquid resistances to prevent waste of electro motive force when resistance is not required. The resistance is short-circuited by adapting to the appliance which carries the movable pole plates, contact pieces, which, when the pole plates are together, come into electrical connection with the fixed contact pieces in the circuit, and bridge over the space between such contact pieces. 1 claim.